

Instruction Manual

iK500 Dry Pumping Systems



 **BOC EDWARDS**

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Declaration of Conformity

We, BOC Edwards,
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declare under our sole responsibility that the product(s)


iK500 Dry Pumping System:	iK500
460 V, 60 Hz, 3-phase	A533-89-908
200/208 V, 50 Hz, 3-phase	A533-89-963
380/415 V, 50 Hz, 3-phase	A533-89-946
230 V, 60 Hz, 3-phase	A533-89-957
200/208 V, 60 Hz, 3-phase	A533-89-964
iH alternative nitrogen and cooling-water connections kit	A505-34-000
iH interface module mounting kit	A505-35-000
iH enclosure extraction fan	A505-39-000
iH/iL light duty exhaust check valve	A505-56-000

to which this declaration relates is in conformity with the following standard(s)
or other normative document(s)

EN60204-1	Electrical Safety; Machines.
EN61326 (Industrial location, Class A Emissions)	Electrical equipment for measurement, control and laboratory use - EMC requirements.
EN1012-2	Compressors and Vacuum Pumps - Safety Requirements: Part 2 - Vacuum Pumps.
SEMI S2-93A	Safety guidelines for semiconductor manufacturing equipment.
EN13463-1	Non Electrical Equipment for Potentially Explosive Atmospheres.

following the provisions of

73/023/EEC	Low Voltage Directive.
89/336/EEC	Electromagnetic Compatibility Directive.
94/9/EC	Equipment for use in Potentially Explosive Atmospheres (ATEX Directive) (Category 3GD) Internal Atmospheres Only.
98/37/EC	Machinery Safety Directive.


Dr J. D. Watson, Senior Technical Manager
Vacuum Equipment and Exhaust Management Product Divisions

10 JUN 2007 SHONHAM
Date and Place

This product has been manufactured under a quality system registered to ISO9001

 **BOC EDWARDS**

iK500 Dry Pumping System - Setup Password

The setup password for this equipment is preset as follows:

SETUP PASSWORD: 202

You can remove this sheet from the instruction manual and retain it in a safe place to prevent unauthorised access to the setup menus in the iK500 system.

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1 INTRODUCTION

1.1 Scope and definitions

This manual provides installation, operation and maintenance instructions for the BOC Edwards iK500 Dry Pumping System. You must use the iK500 system as specified in this manual.

Read this manual before you install and operate the iK500 system. Important safety information is highlighted as WARNING and CAUTION instructions; you must obey these instructions. The use of WARNINGS and CAUTIONS is defined below.

	<p style="text-align: center;">WARNING</p> <p style="text-align: center;">Warnings are given where failure to observe the instruction could result in injury or death to people.</p>
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<p style="text-align: center;">CAUTION</p> <p style="text-align: center;">Cautions are given where failure to observe the instruction could result in damage to the equipment, associated equipment or process.</p>
--

Throughout this manual, page, figure and title numbers are in the form 'S-N', where 'S' specifies the section and 'N' specifies the number of the page, figure or table in the section.

The units used throughout this manual conform to the SI international system of units of measurements. Also, throughout this manual, wherever nitrogen flow rates are specified, the abbreviation 'slm' is used to mean 'standard l.min⁻¹': this is a flow of 1 l.min⁻¹ at an ambient temperature of 0 °C and a pressure of 1013 mbar (1.013 x 10⁵ Pa).

NOTICE

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The following symbols may appear on the iK500 system:



Warning - refer to manual



Warning - heavy object



Warning - risk of electric shock



Warning - moving parts present



Warning - hot surfaces



Warning - use protective equipment



Warning - static sensitive devices



PE PE -Protective earth (ground)



RF earth (ground)



Warning - risk of catastrophic failure

Material Safety Data Sheets for BOC supplied chemicals can be attained by contacting: UK +44 (0) 1293 528844; France +331 (1) 47 98 24 01; Germany +49 (0) 6421 8030, or; USA (transportation emergency) +1 800-424-9300 (other inquiries) +1 800-848-9800.

1.2 ATEX directive implications



- This equipment is designed to meet the requirements of Group II Category 3 equipment in accordance with Directive 94/9/EC of the European Parliament and the Council of 23rd March 1994 on the approximation of the laws of the Member States concerning equipment and protective systems intended for use in potentially explosive atmospheres. (The ATEX Directive).

The ATEX Category 3 applies in respect of potential ignition sources internal to the equipment. An ATEX Category has not been assigned in respect of potential ignition sources on the outside of the equipment as the equipment has not been designed for use where there is an external potentially explosive atmosphere.

There is no potential source of ignition within the pump during normal operation but there may be potential sources of ignition under conditions of predicted and rare malfunction as defined in the Directive. Accordingly, although the pump is designed to pump flammable materials and mixtures, operating procedures should ensure that under all normal and reasonably predicted conditions, these materials and mixtures are not within explosive limits. Category 3 is considered appropriate for the avoidance of ignition in the case of a rare malfunction which allows flammable materials or mixtures to pass through the pump while within their explosive limits.

- When flammable or pyrophoric materials are present within the equipment you must:
 - Not allow air to enter the equipment.
 - Ensure that the system is leak tight.
 - Use an inert gas purge (for example, a nitrogen purge) to dilute any flammable gases or vapours entering the pump inlet, and/or use an inert gas purge to reduce the concentration of flammable gases or vapours in the pump and in the exhaust pipeline to less than one quarter of the gases' published lower explosive limits (LEL).
- For further information, please contact BOC Edwards: refer to the Addresses page at the end of this manual for details of your nearest BOC Edwards company.

1.3 The iK500 system

The iK500 system operates at pressures between atmospheric and ultimate vacuum with no lubricating or sealing fluid in the pumping chamber(s). This ensures a clean pumping system without back-migration of oil into the system being evacuated.

The iK500 system has an HCDP80 dry pump, with an QMB500 mechanical booster pump fitted to the inlet of the HCDP80 pump. The HCDP80 pump is referred to as the HCDP pump and the QMB500 pump is referred to as the QMB pump throughout the remainder of this manual.

Both the HCDP and QMB pumps have enclosed, water-cooled motors. The iK500 system is therefore suitable for applications in clean environments where fan cooling of motors is unacceptable.

The iK500 system has a gas system which introduces purge gas into the HCDP pump. This gas system is suitable for use on harsh duty processes. If you use the iK500 system on light or medium duty processes, you can use the economiser gas mode to reduce the consumption of purge nitrogen by the pumping system.

You can manually control the iK500 system through the Pump Display Terminal: see Section 1.2. Alternatively, you can use your process tool or other control equipment to control the operation of the iK500 system through an Interface Module accessory (refer to Section 8.5.3), or through an iK Communications Module accessory (see Section 8.5.2), or you can use the iK Single Pumpset Monitor accessory to control the operation of the iK500 system (refer to Section 8.5.5). The remainder of this manual describes the use of the Pump Display Terminal to operate the iK500 system: for use of another accessory to operate the iK500 system, refer to the instruction manual supplied with the accessory.

All of the components of the iK500 system are fitted inside an enclosure. Panels of the enclosure should only be removed for access during maintenance and should at no time be removed by the operator.

The components of the iK500 system are described in the following sections.

1.4 The HCDP dry pump

The HCDP pump is a five-stage, positive displacement rotary pump in which pairs of intermeshing rotors (of different profiles mounted on common shafts) are held in correct phase relation by a pair of timing gears. The timing gears and the adjacent angular contact bearings are oil lubricated.

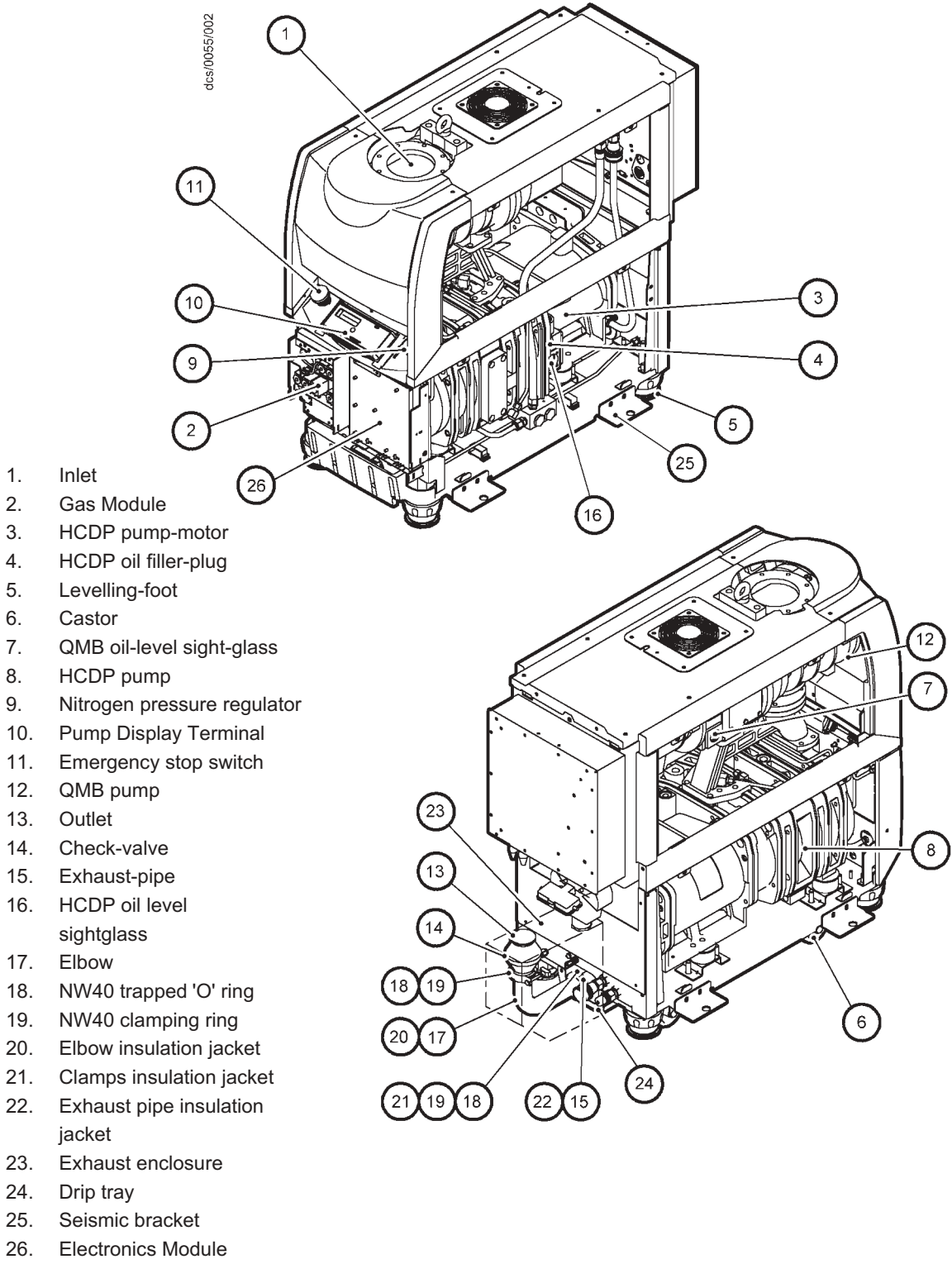


Figure 1-1 - The iK500 system

1.5 The HCDP gas system

The HCDP pump has a gas system which is suitable for use in harsh processes, such as ion implanters, PECVD (Plasma Enhanced Chemical Vapour Deposition), LPCVD nitride, LPCVD TEOS and Silicides. The gas system is also suitable for use in light or medium duty processes.

The gas system can be preset to operate in any one of the following four configurations: low gas; medium gas; medium gas and exhaust; high gas. As supplied, the gas system is preset for the high gas configuration. To change the gas system configuration, refer to Section 5.3.

The gas system has supply pipelines and components (such as valves), a Gas Module with a distribution manifold, gas purge controls and sensors, and pipelines which deliver purge nitrogen to the purge points on the HCDP pump.

The gas system provides the following purge flows to the HCDP pump:

- Shaft-seals purge: this purge flow is on whenever the HCDP pump is on.
- 2/3-interstage purge and 3/4-interstage purge: these purge flows are either both on or both off. The purge flows can be switched on or off by use of the Pump Display Terminal or by your own control equipment.
- Exhaust-purge: this purge flow is on whenever the HCDP pump is on and the gas system is either in the high gas configuration, or in the medium gas and exhaust configuration.
- Inlet-purge: this purge flow is only used in high gas configuration. The purge flow can be switched on or off by use of the Pump Display Terminal or by your own control equipment.

Refer to Figure 1-2 which shows a schematic diagram of the HCDP pump gas system.

The purge flow pressure is controlled by a pressure regulator (26). A mass flow transducer (25) measures the total flow of purge gas to the pump purge points. A check-valve (27) prevents the flow of process gases back into your nitrogen supply pipeline.

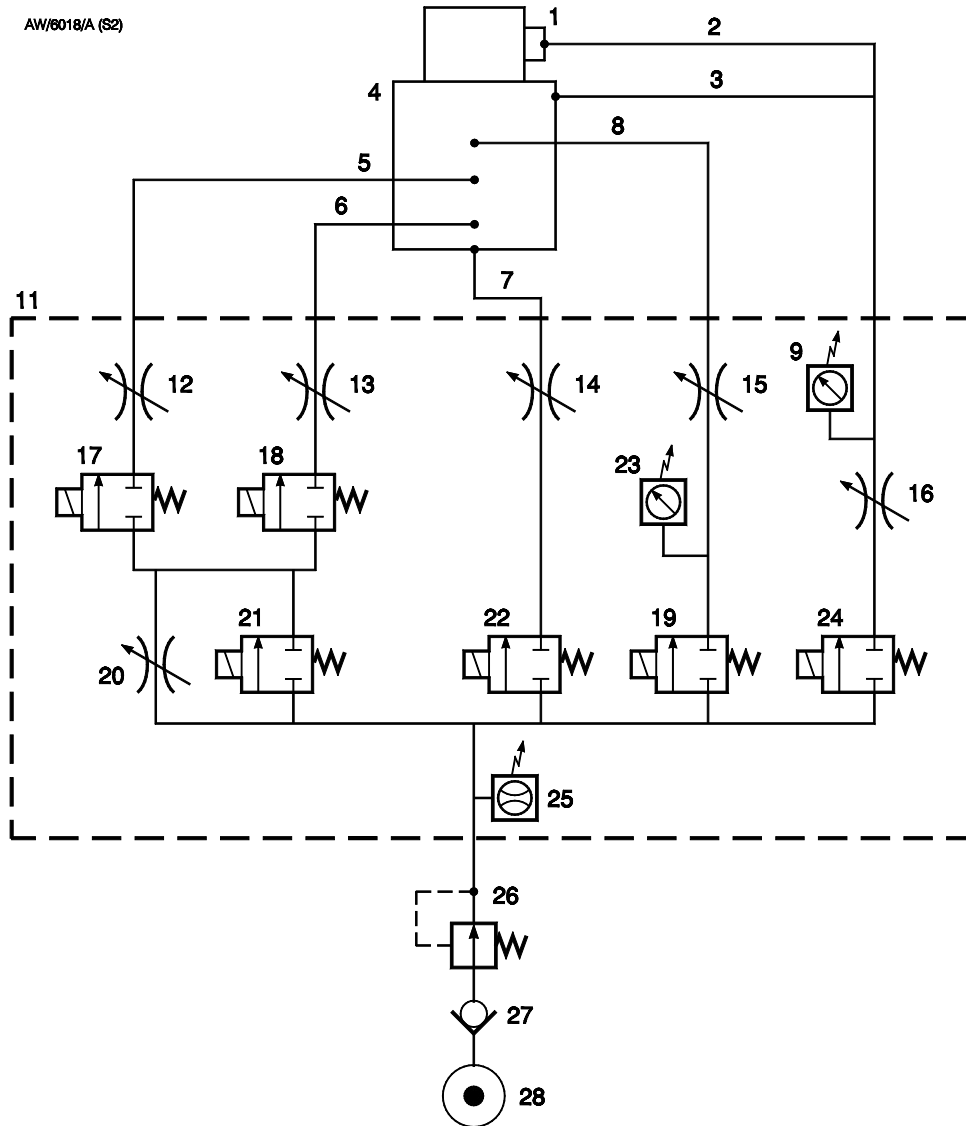
The 3/4-interstage purge and 2/3-interstage purge flows are switched on and off by the solenoid-valves (17 and 18). The inlet-purge, shaft-seals purge and exhaust-purge flows are switched on and off by the solenoid-valves (22, 19 and 24). The 2/3-interstage and 3/4-interstage purges solenoid-valve (21) operates in conjunction with the inlet-purge solenoid-valve (22), to provide reduced interstage purge flow when inlet-purge is switched on.

Variable restrictors (12 to 16 and 20) limit the purge flow rates.

A pressure transducer (23) monitors the pressure of the shaft-seals purge flow, and another pressure-transducer (9) monitors the pressure in the exhaust pipeline. The outputs of the pressure transducers are used to display the shaft-seals purge and exhaust pressures on the Pump Display Terminal.

(Continued on page 1-8)

AW/6018/A (S2)



- | | | | |
|-----|--|-----|---|
| 1. | Two-way gearbox vent-valve | 15. | Variable restrictor (shaft-seals purge) |
| 2. | Gearbox vent pipeline | 16. | Variable restrictor (exhaust-purge) |
| 3. | Exhaust-purge pipeline | 17. | Solenoid-valve (3/4-interstage purge) |
| 4. | HCDP pump | 18. | Solenoid-valve (2/3-interstage purge) |
| 5. | 3/4-interstage purge pipeline | 19. | Solenoid-valve (shaft-seals purge) |
| 6. | 2/3-interstage purge pipeline | 20. | Variable restrictor (2/3 and 3/4-interstage purges) |
| 7. | Inlet-purge pipeline | 21. | Solenoid-valve (2/3 and 3/4-interstage purges) |
| 8. | Shaft-seals purge pipeline | 22. | Solenoid-valve (inlet-purge) |
| 9. | Pressure transducer (exhaust-purge) | 23. | Pressure transducer (shaft-seals purge) |
| 10. | Not used | 24. | Solenoid-valve (exhaust-purge) |
| 11. | Gas Module manifold | 25. | Mass flow transducer |
| 12. | Variable restrictor (3/4-interstage purge) | 26. | Pressure regulator |
| 13. | Variable restrictor (2/3-interstage purge) | 27. | Check-valve |
| 14. | Variable restrictor (inlet-purge) | 28. | Nitrogen supply inlet |

Figure 1-2 - Schematic diagram of the HCDP pump gas system

If there is a pressure rise in the exhaust pipeline, the outputs of the exhaust pressure transducer (9) will bring up warning and alarm messages before causing the iK500 system to be shut down via the relay interlock circuit.

The dashboard has three pressure status LEDs (Figure 1-7, items 3, 5 and 6). These LEDs show whether the nitrogen supply pressure is too high, too low or is in the acceptable range: refer to Section 5.7.

1.6 The QMB mechanical booster pump

1.6.1 Construction

The QMB pumps are positive displacement roots vacuum pumps. The pump mechanism is driven by a three-phase electric motor through a hydrokinetic fluid-coupling. The motor is enclosed and is cooled by integral cooling-water coils.

The pump shafts and rotors are made of high-grade, corrosion-resistant, cast iron. The internal and external shaft-seals are made of polytetrafluoroethylene (PTFE) or fluoroelastomer.

The pump-bearings, gears and seals are lubricated by oil fed from reservoirs in the coupling-cover. A series of seals stops the oil from reaching the vacuum side of the pump. The coupling-cover is evacuated. You can inspect the oil-levels through sight-glasses which are fitted to the coupling-cover. Oil-filler, oil-drain and external evacuation connections are provided on the cover.

The QMB pump has rear bearings which are lubricated by perfluoropolyether (PFPE) grease. The QMB pump is only suitable for use with PFPE oils.

1.6.2 Principle of operation

The QMB Mechanical Booster Pump is shown in Figure 1-3. The motor-shaft drives one of the rotors through the fluid-coupling. The 1:1 gears inside the coupling-cover drive the second rotor in the opposite direction inside the stator housing. A small, accurately gauged, clearance is maintained between the rotors and between each rotor and the stator wall. This clearance allows the pump to operate at high speed without mechanical wear and without the need for lubrication inside the swept volume.

1.6.3 Hydrokinetic fluid-coupling

The hydrokinetic fluid-coupling connects the electric-motor shaft to the rotor. This system is configured so that when the gas-load is high the rotational speed of the rotors is reduced. As the gas-load decreases, the rotors accelerate to full speed. This allows continuous operation of the pump over the vacuum range without the risk of overloading the motor and removes the need for bypass-valves and associated pipelines.

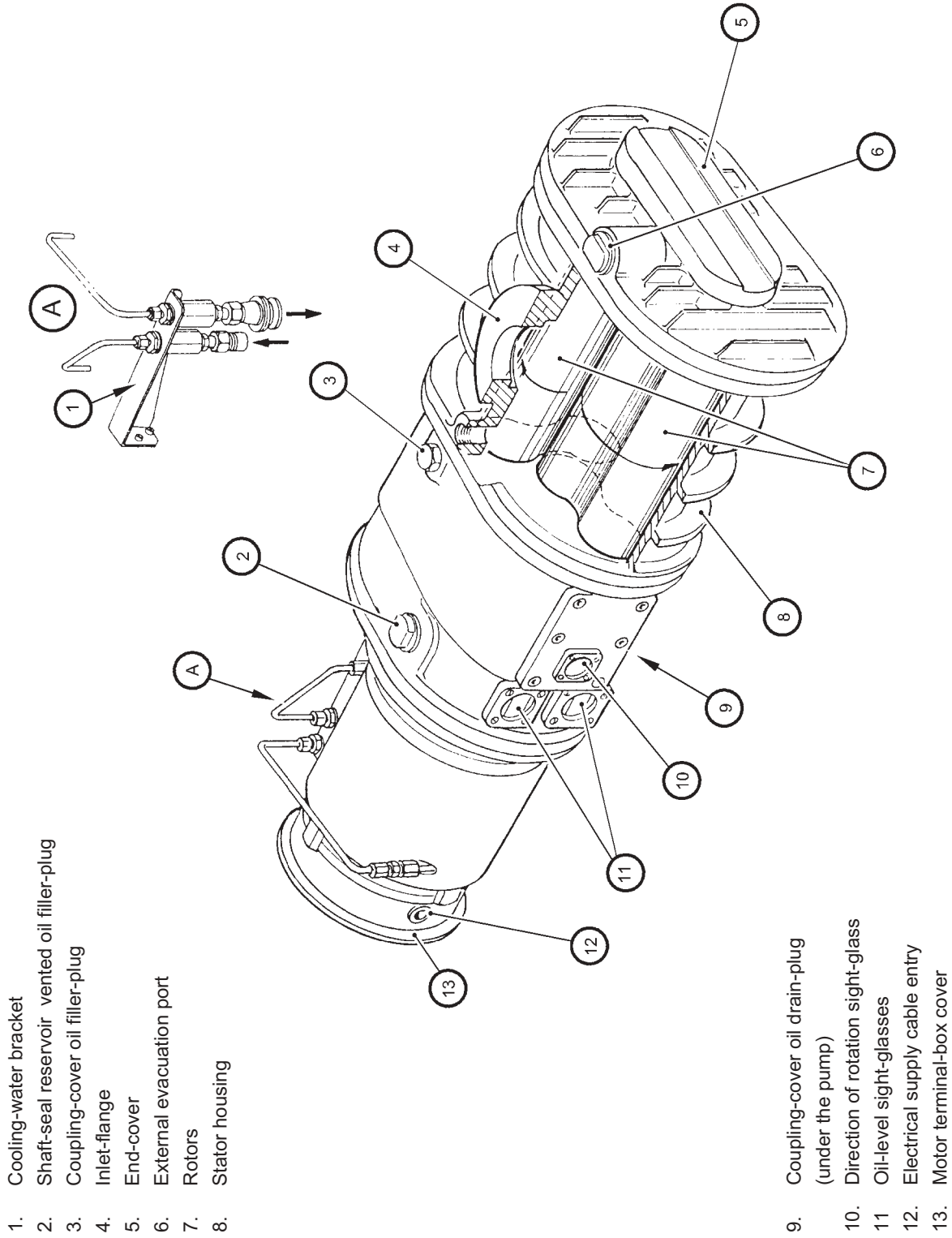


Figure 1-3 - QMB Mechanical booster pump (part cut-away)

1.7 Temperature control system

1.7.1 HCDP pump temperature control system

The headplate and the fourth stage of the HCDP pump have a direct cooling system in which water flows around these parts of the pump. All other stages of the pump are air-cooled by natural convection and radiation.

The pump-motor is cooled by water which flows through a cooling jacket which surrounds the motor. The cooling-water supply and return pipelines are connected to the iK500 system by connectors at one end of the iK500 system (Figure 1-5, items 2 and 3).

The cooling-water manifolds on the pump distribute the cooling-water to the pump cooling circuit and to the pump-motor cooling circuit and to the QMB pump-motor cooling circuit. The manifold on the pump headplate also houses a control plug and a blanking plug, which are used to configure the cooling water system for optimal operating temperature. (see Section 3.5).

A surface temperature sensor (Figure 1-6, item 9) is fitted to the pump-body to measure the temperature of the pump-body. The output of the thermocouple is monitored by the iK500 control system: see Section 1.9.3.

For safety reasons, a shut-down thermistor is fitted to the pump headplate manifold block. The thermistor is a solid state device which has a resistance that changes with temperature. The thermistor is connected to the iK500 control system and is used to provide a warning of cooling system failure. It is also connected to the relay interlock circuit and will cause the iK500 system to be shut down if the temperature exceeds 60°C.

A motor-protection thermistor is fitted to the pump-motor. This thermistor is a solid-state device which has an electrical resistance of less than 750 Ω at normal pump-motor operational temperature. If the pump-motor is too hot, the electrical resistance rises quickly to 4000 Ω or more. The thermistor is connected to the relay interlock circuit and will cause the system to be shut down if the pump-motor is too hot.

A water flow-switch is fitted in the pump-motor water manifold. The output of the flow-switch is monitored by the iK500 control system and provides an indication of low water flow through the pump.

1.7.2 QMB pump temperature control system

The QMB is cooled by ambient air. The pump-motor is cooled by water which flows through a cooling jacket which surrounds the pump-motor. The pump-motor cooling-water supply and return pipelines are connected to the cooling-water system on the HCDP pump.

A motor-protection thermistor is fitted to the pump-motor. This thermistor is a solid-state device which has an electrical resistance of less than 750 Ω at normal pump-motor operational temperature. If the pump-motor is too hot, the electrical resistance rises quickly to 4000 Ω or more. The thermistor is connected to the relay interlock circuit and will cause the system to be shut down if the pump-motor is too hot.

A temperature sensor probe (Figure 1-6) is fitted to the booster end cover. The output of the sensor is monitored by the iK500 control system: to provide a warning that the booster is overheating.

1.8 Exhaust system

The outlet of the HCDP pump is connected to an exhaust-pipe, which is below the pump. The outlet also has a port which allows gearbox vent gases to join the main exhaust stream (see Figure 1-2).

The final stage of the HCDP pump is a positive displacement Roots stage, which attenuates the gas pressure pulses from the claw stages in the pump. This pump configuration reduces pump-induced resonance in your exhaust-extraction system and removes the need for an exhaust silencer.

An elbow is fitted to the outlet of the exhaust pipe. The outlet of the elbow has a check valve which prevents the suck-back of exhaust vapours after the iK500 system is shut down. The check-valve also provides additional attenuation of the pulses in the exhaust pressure. If required, you can remove the elbow and/or the check valve for your specific process (see Section 3.10). The exhaust pipe, elbow and joint between pipe and elbow are fitted with insulation jackets to reduce heat loss from the exhaust system.

You can fit an exhaust temperature sensor accessory to the end of the exhaust pipe (between the elbow and the check valve, if fitted): see Section 8.4.1. When fitted, the output of the sensor is monitored by the iK500 control system and is used to provide an indication of exhaust gas temperature.

1.9 Electrical system

Refer to Figure 1-4 which shows schematic diagrams of the electrical and control systems of the iK500 systems.

-
- | | |
|---|--|
| 1. Electrics Box | 25. Emergency stop switch |
| 2. Gas Module | 26. RJ12 connector for PDT |
| 3. Electronics Module | 27. Not used |
| 3A. Control SMA | 28. QMB temperature sensor |
| 4. Pump Display Terminal | 29. Not used |
| 5. External electrical supply | 30. Exhaust temperature sensor * |
| 6. Electrical supply connector | 31. HCDP pump-body temperature sensor |
| 7. Protective earth (ground) stud | 32. Control PL3 connector |
| 8. Exhaust Gas Management interface | 33. Gas module PL4 connector |
| 9. Tool Interface Module connector | 34. Water flow-switch |
| 10. Pump Display Module * | 35. Not used |
| 11. iK500 Tool Interface Module fuse holder | 36. Dashboard PL1 connector |
| 12. Emergency stop fuse holder | 37. Sensors PL2 connector |
| 13. HCDP electrical supply | 38. Not used |
| 14. HCDP motor terminal-box | 39. Solenoid-valves (6 off) |
| 15. HCDP motor thermistor cable | 40. Pressure transducers (2 off) |
| 16. QMB electrical supply | 41. Mass flow transducer |
| 17. QMB motor terminal-box | 42. Dashboard LEDs |
| 18. QMB motor thermistor cable | 43. Not used |
| 19. RF earth (ground) stud | 44. 4-way XLR connector for PDM |
| 20. Cooling-fan connector | 45. Active Gauge connector * |
| 21. Not used | 46. Lower rear bulkhead cover |
| 22. Not used | 47. d.c. electrical supply fuse holder |
| 23. Pump shut-down thermistor | 48. Active gauge cable connector |
| 24. Not used | 49. Sensor connector |

* Optional accessory

Figure 1-4 - Schematic diagram of the iK500 electrical systems: key

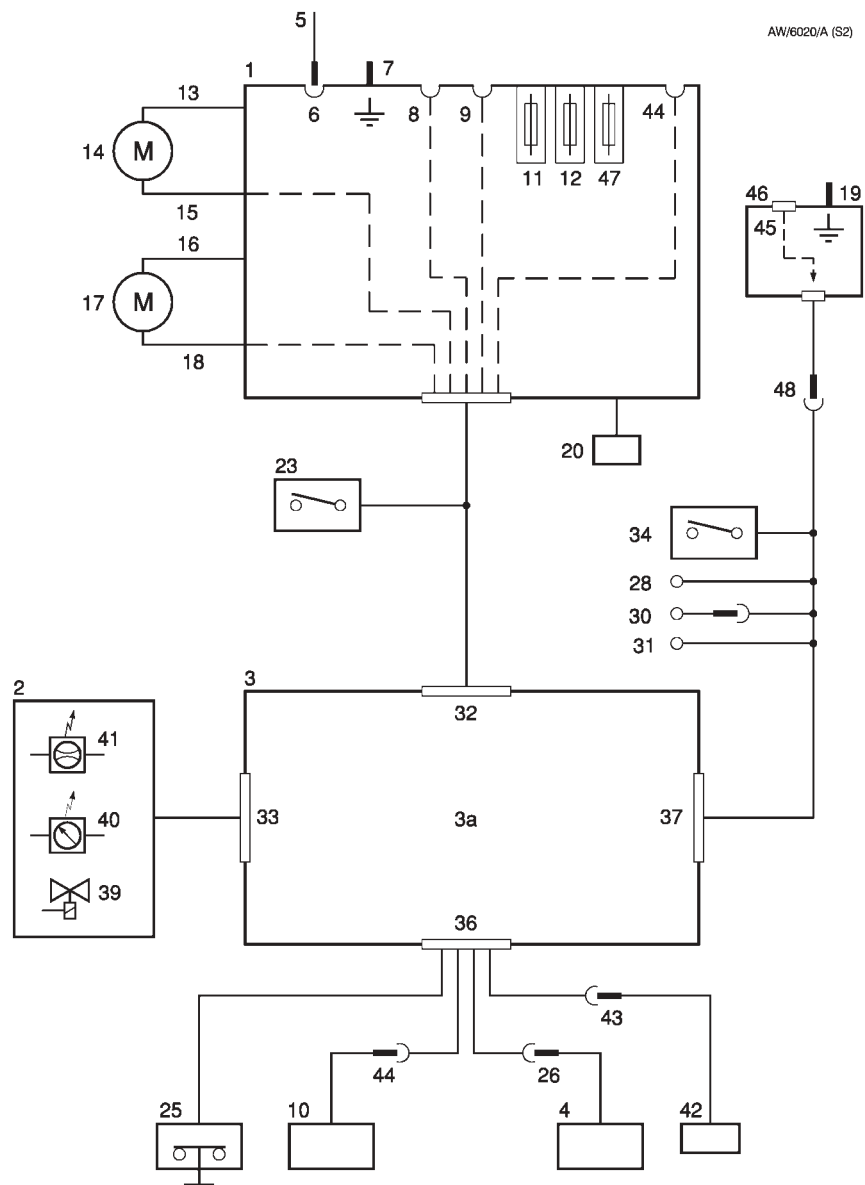


Figure 1-4 - Schematic diagram of the iK500 electrical system

1.9.1 Introduction

Refer to Figure 1-4. The iK500 system has an Electrics Box (1), an Electronics Module (3), a Gas Module (2) and a Pump Display Terminal (4). Optionally, your iK500 system may have an iK Interface Module, an iK Communications Module and other accessories, such as an exhaust temperature sensor.

All of these Modules communicate through a serial data network. Each Module on the network has a microprocessor, which controls the network communications and also contains the default setpoints for the sensors in or connected to the Modules (see Section 2).

1.9.2 Electrics Box

Refer to Figure 1-4. The external electrical supply (5) is connected to the electrical supply connector (6) on the Electrics Box (1). The Electrics Box switches the electrical supplies to the HC DP pump and to the QMB pump. The Electrics Box also provides the electrical supplies to the other Modules in the iK500 system.

The Electrics Box has contactors for the HC DP pump and the QMB pump, pump power and current consumption sensors and short-circuit protection. The Electrics Box also has a transformer and fuses for the 24 V control circuits and fuses for the following supplies: iK500 Interface Module (11) and DC electrical supply (47). Three thermal-type, self-resetting fuses in the Electrics Box protect the DC electrical supplies to the network.

Refer to Figure 1-5 detail C. The rear panel of the Electrics Box has the following lamp and connections:

Power on lamp (7)	This lamp is on when the electrical supply to the Electrics Box is on.
Tool Interface Module connector (8)	Use this to connect an iK500 Tool Interface Module to the iK500 system (see Section 8.5.3); or to connect an external emergency stop circuit to the iK500 system (see Section 3.15); or to connect a Disconnect Box to the iK500 system (see Section 3.21).
LON Interface Connector (9)	Use this to connect the iK500 system to a network.
Electrical supply connector (10)	Use this to connect your external electrical supply to the iK500 system: refer to Section 3.16.3.
Protective earth (ground) stud (11)	If required, use this to make additional protective earth (ground) connections: refer to Section 3.16.3.
Exhaust Gas Management interface (12)	If required, use this connector to connect the iK500 system to a BOC Edwards Exhaust Gas Management.
Fuse holder F7 (13)	This fuse protects the d.c. electrical supply.
Fuse holder F9 (14)	This fuse protects the emergency stop circuit.

Fuse holder F8 (15) This fuse protects the iK Interface Electrics Box (if fitted).

Refer to detail D. Fuses inside the Electrics Box (16 to 21) protect the internal circuits of the Electrics Box. Note that you cannot change these fuses; a BOC Edwards service engineer must change these fuses.

Refer to detail B. The rear panel of the iK500 system has the following connections:

Active gauge connector (5) This connector is only available if you have fitted an Active Gauge Connection Kit (see Section 8.4.3). Use this to connect the active gauge to the iK500 system.

RF earth (ground) stud (6) If required, use this to make additional RF earth (ground) connections: refer to Section 3.16.4.

Refer to Figure 1-6. The bottom panel of the Electrics Box has the following cables and connectors:

Electrics and Control Loom (14) This is used to provide power, measurement signals and control signals to the Electronics Module.

HCDP electrical supply cable (15) This is used to connect the electrical supply from the Electrics Box to the HCDP pump.

HCDP thermistor cable (16) This is used to connect the output of the thermistor in the HCDP pump to the Electrics Box.

QMB thermistor cable (18) This is used to connect the output of the thermistor in the QMB pump to the Electrics Box.

QMB electrical supply cable (19) This is used to connect the electrical supply from the Electrics Box to the QMB pump.

1.9.3 Electronics Module

This Module communicates with the Gas Module, the Pump Display Terminal and the optional Interface Module accessories. The following sensors are connected to the Electronics Module:

- HC DP pump-body and pump-motor water manifold temperature sensors.
- QMB booster end cover temperature sensor.
- Exhaust temperature sensor (if fitted).
- Water flow-switch.

The Module has a microprocessor which:

- Monitors the status of the system.
- Sends warning and alarm messages (see Section 1.11.2) to other Modules connected to the iK500 system.
- Monitors the control inputs (from the Pump Display Terminal or the Interface Module accessory) and switches the pumps on and off as requested.
- Shuts down the iK500 system if a sensor reading is outside specified alarm range: see Section 1.11.2.

The Module communicates with and controls the operation of the Gas Module.

Internal clocks and counters in the Module measure the operating time of the iK500 system and keep count of the number of iK500 system switch-on / switch-off and process cycles.

1.9.4 Gas Module

The Gas Module communicates with and is controlled by the Electronics Module. The operation of the nitrogen purge supply solenoid-valves in the Gas Module is described in Section 1.5.

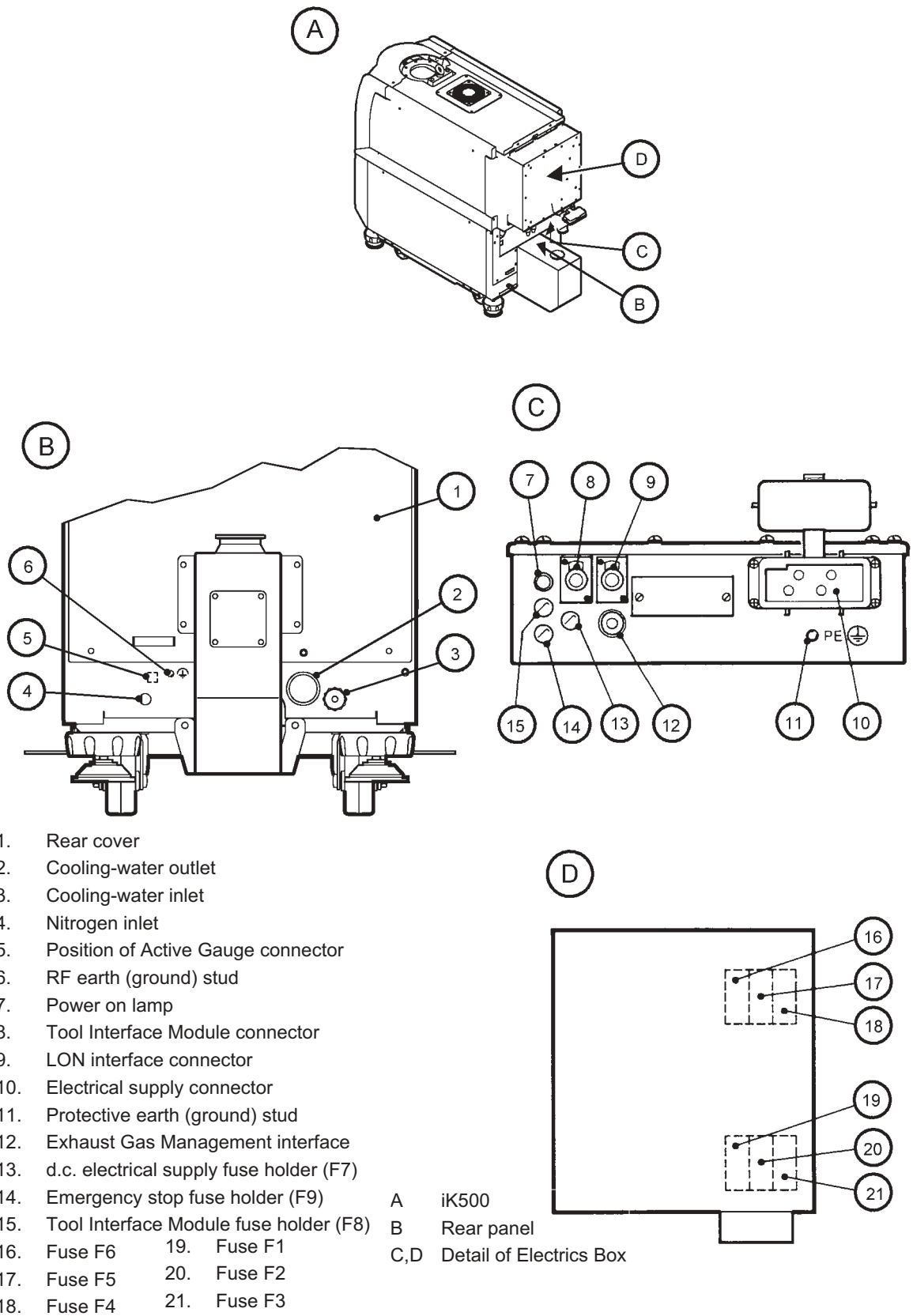
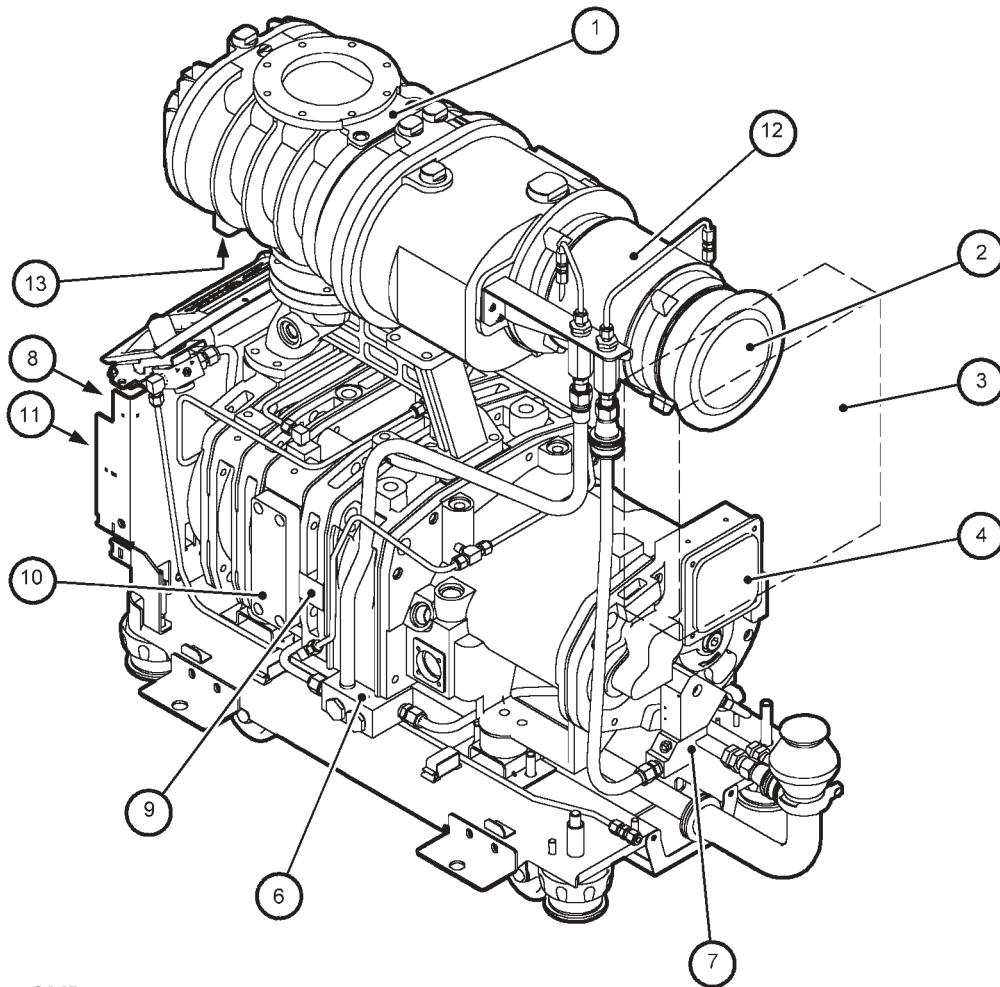


Figure 1-5 - Services and electrical connections on the rear of the iK500 system



dcs/00555/003

1. QMB pump
2. QMB pump-motor terminal-box
3. iK500 Electrics Box
4. HCDP pump-motor terminal box
5. Not used
6. HCDP pump shut-down thermistor
7. HCDP pump water flow-switch
8. Gas Module
9. HCDP pump-body temperature sensor
10. HCDP pump
11. Electronics Module
12. QMB pump-motor
13. QMB booster endcover temperature sensor
14. Electrics and Control Loom
15. HCDP pump electrical supply cable
16. HCDP pump-motor thermistor cable
17. Not used
18. QMB pump-motor thermistor cable
19. QMB pump electrical supply cable

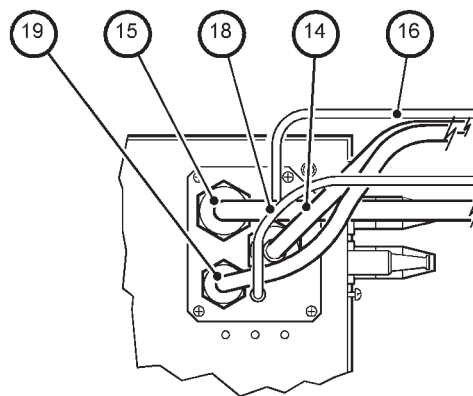
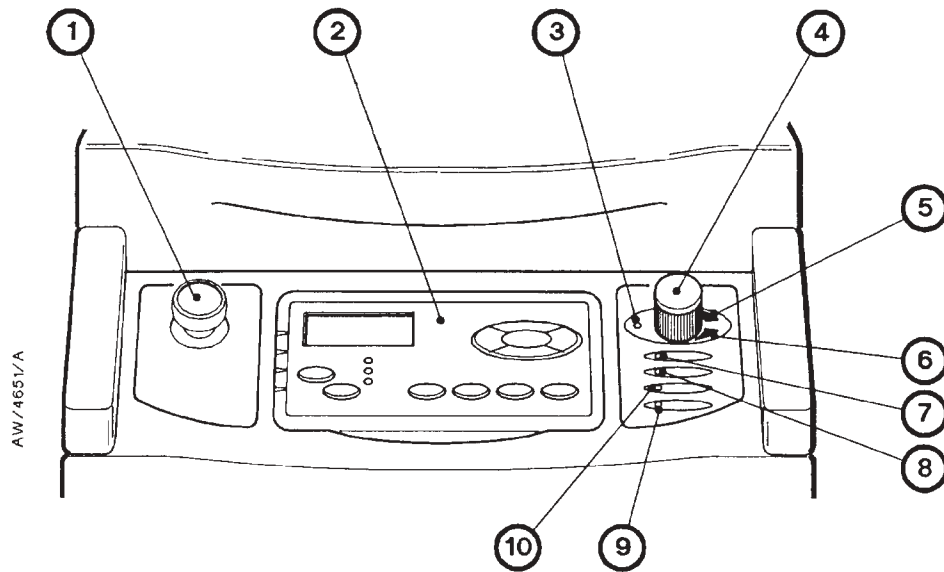


Figure 1-6 - Electrical components (shown without enclosure for clarity)

1.10 Controls and indicators

Refer to Figure 1-7. The controls and indicators on the dashboard of the iK500 system are as follows:

Emergency stop switch (1)	Press this to immediately shut down the iK500 system in an emergency: refer to Section 5.12.
Pump Display Terminal (2)	Use this to control the iK500 system: refer to Section 1.12.
Shaft-seal purge pressure warning LED (3)	This yellow LED is on when the shaft-seals purge nitrogen pressure is too high or too low.
Nitrogen supply pressure regulator (4)	Use this to adjust the nitrogen supply pressure.
Shaft-seal purge pressure high and low LEDs (5, 6)	These green LEDs are both on when the shaft-seals purge nitrogen pressure is acceptable. The pressure high LED (5) is off when the pressure is too low, and the pressure low LED (6) is off when the pressure is too high.
Power OK LED (7)	This green LED is on when the 24 V electrical supply to the Electronics Module is on.
Running LED (8)	This green LED is on when the iK500 pumps are operating.
Alarm LED (9)	This red LED is on when an alarm condition exists: see Section 1.11.
Warning LED (10)	This yellow LED is on when a warning condition exists: see Section 1.11.



- | | |
|--|---|
| 1. Emergency stop switch | 6. Shaft-seals purge pressure low LED (green) |
| 2. Pump Display Terminal | 7. Power OK LED (green) |
| 3. Shaft-seals purge pressure warning LED (yellow) | 8. Running LED (green) |
| 4. Nitrogen pressure regulator | 9. Alarm LED (red) |
| 5. Shaft-seals purge pressure high LED (green) | 10. Warning LED (yellow) |

Figure 1-7 - Controls and indicators on the dashboard

1.11 Control functions

1.11.1 Priority of control

The iK500 system can be controlled by a number of modules: the Pump Display Terminal (see Section 1.12); an iK500 Interface Module (see Section 8.5.3); or the iK Single Pumpset Monitor (see Section 8.5.5). Only one module can have control of the iK500 system at any one time. That is, once a module has control of the iK500 system, control requests from another Module are denied.

To allow another Module to control the iK500 system:

- The Module which currently has control must 'release' control (that is, you must send the appropriate message on the network or press the appropriate button to release control).
- Any Module which requires control must then 'take' control (that is, you must send the appropriate message to the iK500 system or press the appropriate button to take control).

Note that when you first switch-on the electrical supply, no Module will initially have control of the iK500 system. The Module which you want to control the iK500 system must take control as described above.

1.11.2 Setpoints, warning and alarm conditions

Note: Sensors which generate alarm and warning messages are not safety sensors: see Section 1.11.3.

Each Module which monitors sensors has a microprocessor. Each monitored sensor (except for switch-type sensor which have only two output states: error or no error) has four associated setpoints. The setpoints are: the low warning setpoint, the high warning setpoint, the low alarm setpoint and the high alarm setpoint. The microprocessor compares the sensor data to the setpoints to determine if an alarm or warning condition exists:

- If the sensor data is below the low warning setpoint or above the high warning setpoint, a warning condition exists. A warning condition means that some aspect of the operation of the iK500 system is abnormal. The iK500 system will continue to operate.
- If the sensor data is below the low alarm setpoint or above the high alarm setpoint, an alarm condition exists. An alarm condition means there is a serious fault which results in the shut-down of the iK500 system to prevent damage to the iK500 system. However, note that for some of the alarm conditions, you may be able to continue to operate the iK500 system if you have configured the iK500 system to 'run till crash': see Section 5.11.

If an alarm or warning condition exists, an appropriate alarm or warning message is displayed on the Pump Display Terminal and an appropriate alarm or warning indication is sent to other Modules on the network. Refer to Table 6-2 and 6-3 for a full list of the Pump Display Terminal warning and alarm messages.

You can use the default setpoints or you can use a Single Pumpset Monitor to adjust the setpoints to suit your application: refer to Section 5.3. Refer to Section 2 for the default setpoints.

1.11.3 Safety sensors

The iK500 system has a number of safety sensors, which are connected to the relay interlock circuit. If any of the safety sensors cause the interlock relay to operate, the iK500 system is immediately shut down.

The iK500 system can also be fitted with a photohelic switch accessory. If it operates, all electrical power to the iK500 system is removed via the disconnect box. (See Section 1.17 and 1.18).

Table 1-1 shows the safety sensors and the shut down conditions.

Safety sensor	Shut-down condition
HCDP pump-motor thermistor	When the thermistor in the HCDP pump-motor indicates that the temperature of the pump-motor is nominally 150 °C.
QMB pump-motor thermistor	When the thermistor in the QMB pump-motor indicates that the temperature of the pump-motor is nominally 160 °C.
Exhaust pressure transducer	When the pressure in the exhaust pipeline is 9 psig or higher.

Table 1-1 - Safety sensors

Safety sensor	Shut-down condition
HCDP pump shut-down thermistor	When the thermistor indicates that the temperature of the HCDP pump head plate manifold is 60°C or higher.
Photohelic switch (accessory)	When the pressure in the enclosure exceeds the setpoint.

Table 1-1 - Safety sensors (continued)

1.12 Pump Display Terminal

The Pump Display Terminal allows you to manually control the iK500 system and to display the status of the iK500 system. Refer to Figure 1-8 which shows the front panel of the Pump Display Terminal.

Note: Only an iH Pump Display Terminal must be used with the iK500.

Use the On button (1) to switch on the iK500 system (refer to Section 5.6). The On button has a green LED which is on when the iK500 system is on. Use the Off button (10) to switch off the iK500 system (refer to Section 5.10).

The display (2) shows two lines of text; each line is 16 characters long. In normal operation, the Normal display is shown; the Normal display has two pages, and each page has two lines. Each page of the Normal display shows the current status of one or more iK500 system sensors or internal clocks and counters.

As supplied the first page of Normal display shows HCDP pump power consumption and HCDP pump body temperature, and the second page shows QMB pump power consumption and QMB pump-motor temperature. You can change the information shown on the Normal display: refer to Section 5.4.

At any time, you can press one of the four menu buttons (7) to select a new menu. You can then use the up (5), down (3), ENTER (6) and CANCEL (4) buttons to move through the menu. The appropriate menu selected LED (8) is on when the corresponding menu is in use.

Use the menu (7), up (5), down (3), CANCEL (4) and ENTER (6) buttons as described below. Refer to Section 4 for a full definition of the menu structures and the display formats.

Button	LED colour	Button use
Normal	Green	Press this button to select the Normal display (see above).
Control	Green	Press this button to select the Control menu. You can then take control or release control of the iK500 system (see Section 5.5).
Status	Green	Press this button to select the Status menu. In this menu, you can display the current values of all iK500 system sensors.
Setup	Green	Press this button to select the Setup menu. In this menu you can: manually control the operation of iK500 gas purges and gate valves fitted to the vacuum system (and connected to the iK500 through an iK Interface Module with an Auxiliary Interface Card); select 'Run till Crash'; change other display parameters (such as the pressure units used when pressures are displayed and the timeout time). The Setup menu also allows you to select the Service menu; in this menu, you can zero the Gas Module flow transducer and manually operate the components of the iK500 system.
ENTER	-	Use this button to select a currently displayed menu option or to enter a currently displayed parameter.
CANCEL	-	Use this button to cancel the currently displayed menu or option and return to the previous menu or option.
Up/down	-	Use these buttons to move up or down menu options or to increase or decrease a displayed parameter.

The status LEDs (9) show the current status of the iK500 system and the Pump Display Terminal:

LED	LED colour	Meaning
ALARM	Red	This LED shows when an alarm condition exists.
WARNING	Amber	This LED shows when a warning condition exists.
LOCAL CONTROL	Green	This LED is on when the Pump Display Terminal has control of the iK500 system.

The ALARM and WARNING LEDs flash when the corresponding alarm or warning condition first occurs. When you acknowledge the condition (refer to Section 5.9), the corresponding LED goes on permanently. For most alarms and warnings, if the condition clears (that is, the fault which caused the condition is no longer present), the corresponding LED goes off; see Tables 6-2 and 6-3 for the warnings and alarms whose LEDs do not automatically reset in this way.

If remote operation in excess of 25m is expected, a Pump Display Module should be used. The functionality of the Pump Display Module is the same as that of the Pump Display Terminal. Refer to Section 8.5.8 for ordering information.

1.13 Drip Tray

The drip tray is fitted to the bottom of the iK500 frame (see Figure 1-1) and allows the collection of potentially spilled liquids from the iK500 system, thereby satisfying SEMI S2 requirements.

1.14 Seismic Brackets

The four seismic brackets, which are also used to secure the iK500 system to a pallet during transit (see Figure 3-1), are fitted to the side of the iK500 frame. These brackets can be used to protect the iK500 system during zone 4 earthquake conditions, thereby satisfying SEMI S2 requirements.

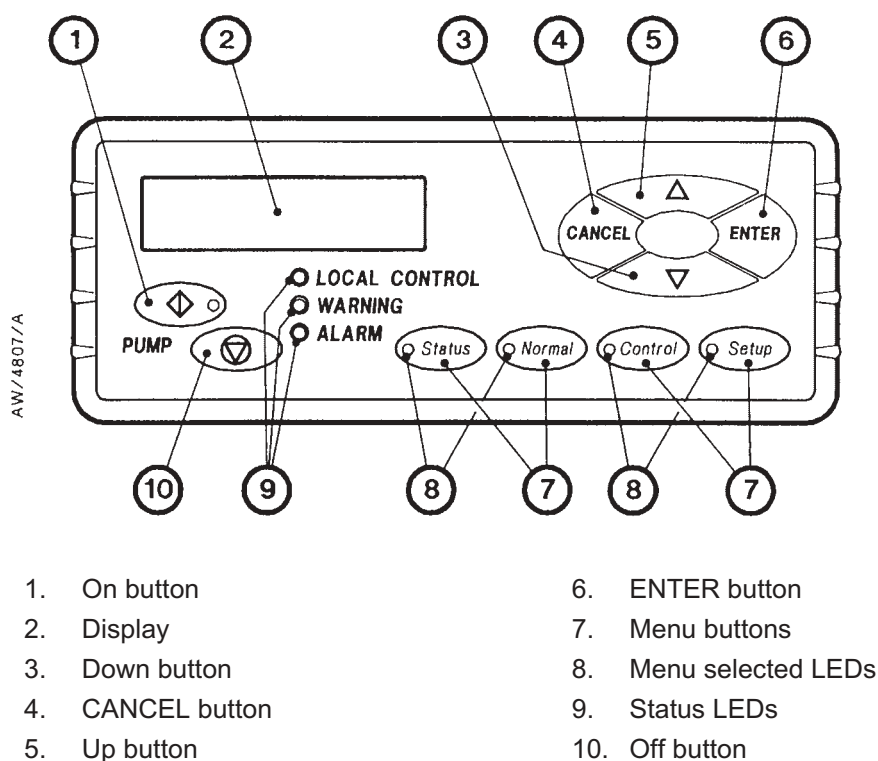


Figure 1-8 - Front panel of the Pump Display Terminal

1.15 Labels

The labels provided warnings, as required, against potential hazards, thereby satisfying SEMI S2 requirements.

The labels are placed on the iK500 system to: identify components; state required operating procedures; and warn of residual risks. Figures 1-10 and 1-11 show the position and text of these labels.

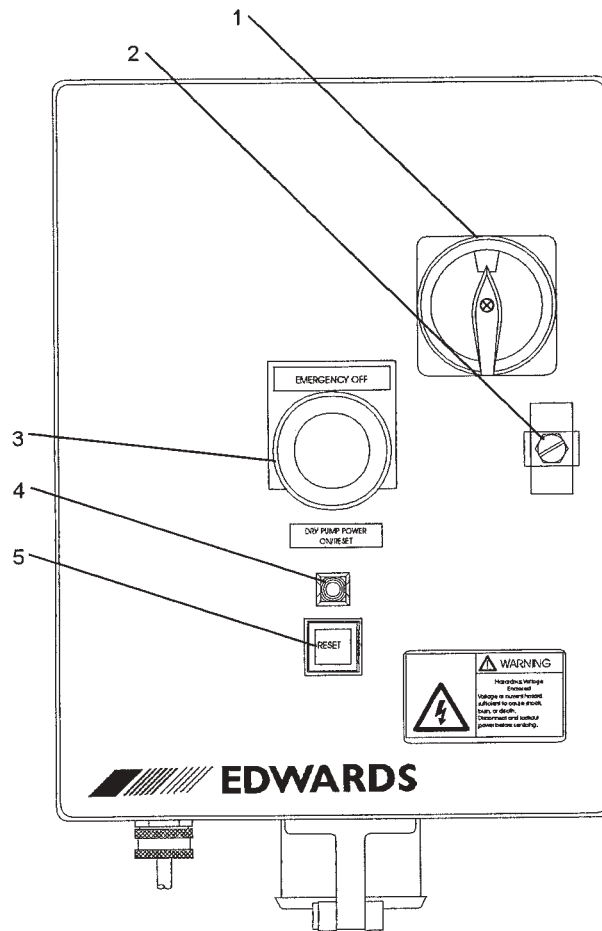
1.16 Exhaust Enclosure

The exhaust enclosure fits around the exhaust pipe and check valve (see Figure 1-1) and provides a means of extracting the enclosure in the event of an exhaust leak from the system, thereby satisfying SEMI S2 requirements.

1.17 iK500 Disconnect box (accessory)

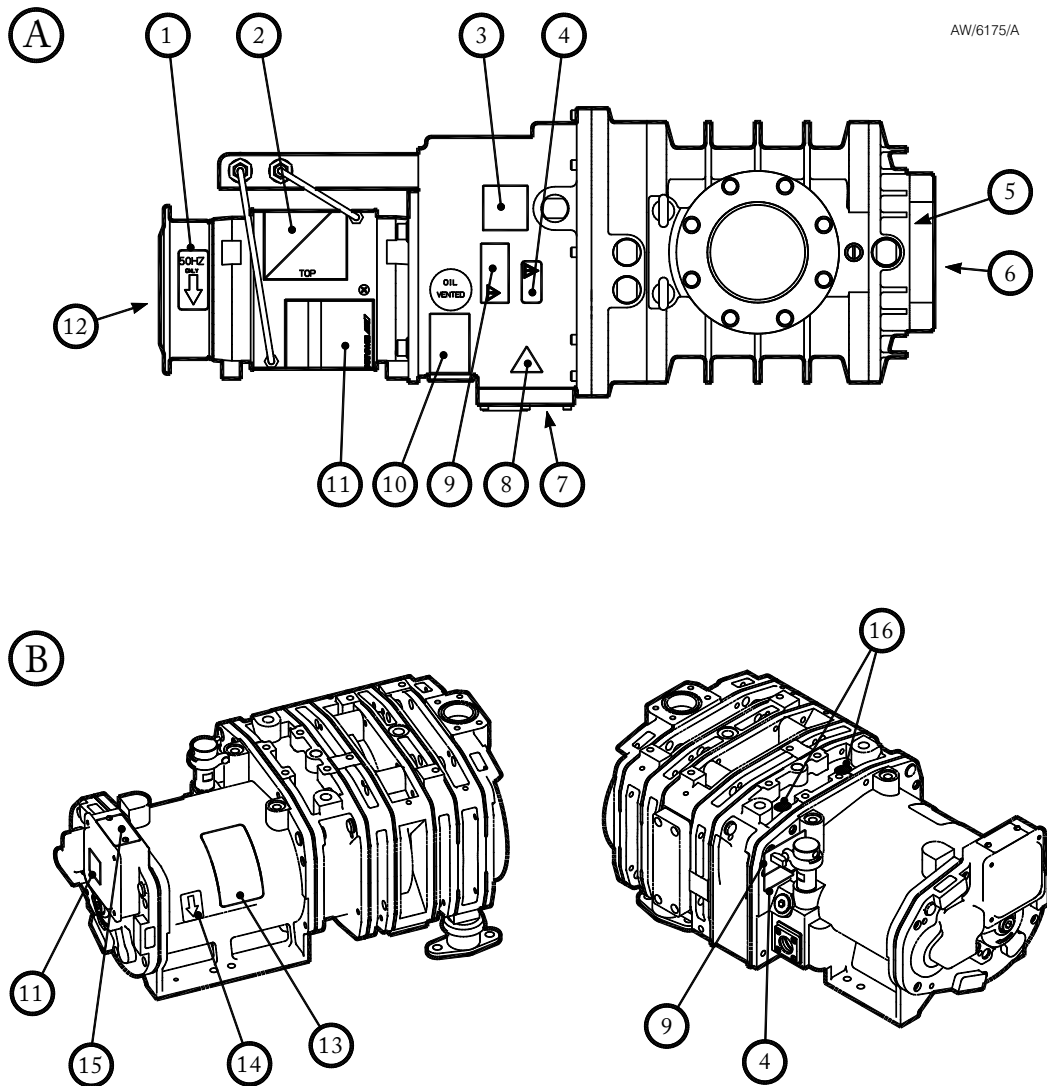
The iK500 disconnect box accessory is used to energise and isolate the power supply to the iK500 system. It also allows the isolation of the electrical supply during an emergency, and for maintenance and troubleshooting the system, thereby satisfying SEMI S2 requirements. Refer to Section 8 for ordering information.

The functions of the disconnect box are described in the following sections. The disconnect box control panel is shown in Figure 1-9.



- | | |
|-------------------------|---|
| 1. Isolation switch | 4. Dry pump power ON/Reset indicator lamp |
| 2. Door lock | 5. Dry pump power On/Reset push button |
| 3. Emergency off button | |

Figure 1-9 - Disconnect Box control panel

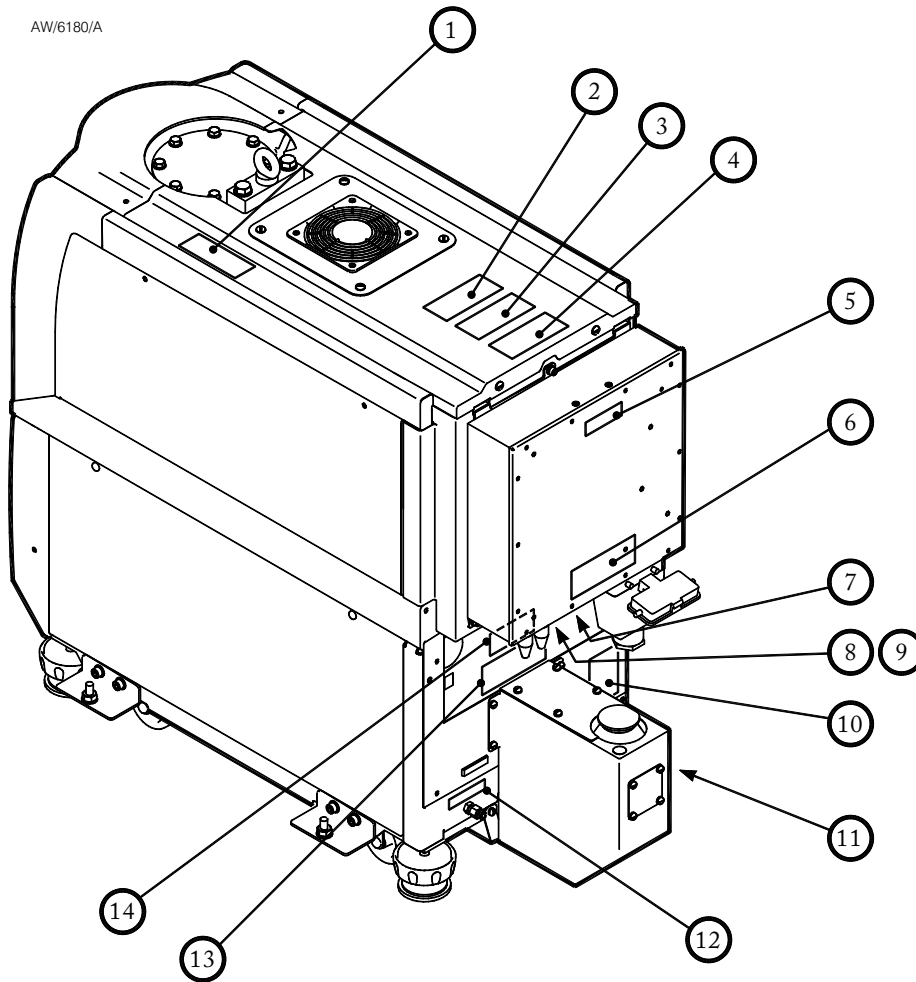


- A. QMB
- B. HCDP

- | | |
|--|---|
| <ul style="list-style-type: none"> 1. Direction of rotation arrow/frequency 2. Do not step on/motor damage pictorial 3. Coupling cover filler plug/
Oil level lower sight glass symbol 4. Use only Fomblin Y16/6 or Krytox 1514 oil 5. Regrease bearing in accordance with instruction manual 6. QMB Information/
Warning! Risk of high temperature symbol 7. Caution! symbol | <ul style="list-style-type: none"> 8. Warning! Risk of high temperature symbol 9. Caution! Do not overfill with oil 10. Use vented plug only/Shaft seal reservoir 11. QMB Motor rating label 12. Warning! Risk of electrical shock symbol 13. HCDP Information/
Warning! Risk of high temperature symbol 14. Direction of rotating arrow 15. HCDP Motor Rating Plate 16. M16 Eyebolt |
|--|---|

Figure 1-10 - Label Positions on QMB and HCDP

AW/6180/A



- | | |
|---|--|
| 1. Warning! Moving Parts Present | 8. Protective Earth symbol |
| 2. Caution! Hot Surface | 9. External Protective Earth Conductor symbol |
| 3. Caution! Heavy Object | 10. System Information/
Warning! Risk of High Temperature |
| 4. Warning! Hazardous Chemicals Enclosed | 11. H ₂ O ≤100 PSIG (≤6.9 bar) |
| 5. Voltage variant | 12. N ₂ 20-100 PSIG (1.4-6.9 bar) |
| 6. Warning! Disconnect mains supply before
Removing Electrics Box covers | 13. Warning! Switch off before disconnecting |
| 7. Warning! Risk of Electric shock | 14. ETL Listing Label |

Figure 1-11 - Label Positions on iK500 System Enclosures

1.17.1 Start Control

The disconnect box has a DRY PUMP POWER ON/RESET push button for operational control of the iK500 system power supply.

1.17.2 Emergency Off Control

If an emergency condition arises, the pump system can be shut down in two ways: red EMERGENCY OFF button located on the control panel, or; EMO signal through 6-way XLR connector from the pump. If the EMERGENCY OFF push button is used, the button must be reset by twisting the button until it releases back out, prior to restarting the system with the use of the DRY PUMP POWER ON/RESET push button.

1.17.3 Brownout Protection

The disconnect box is equipped with a time delay relay which enables the system to continue running as normal if a brownout occurs (of 3 seconds or less). If the brownout lasts over 3 seconds the disconnect box will shutoff power to the system. If this occurs, it will be necessary to restart the system by using the DRY PUMP POWER ON/RESET push button after the condition is corrected.

1.17.4 Circuit Protection

The disconnect box circuits are protected by circuit breakers and fuses. Refer to Fig. 3-16.

The supply voltage to the box is protected by a 35 amp fused mains disconnect. If any of the fuses fail (F1-F3), the power to the disconnect box will be disabled and the iK500 system will be shut down.

The transformer primary is protected by two (2) fuses, F4 and F5. If either of these fuses fail, the 24 VAC control circuit is shutdown and the pump system is switched off.

The 24VAC system is protected by a single fuse, F6. If this fuse fails, the control circuit is shut down and the system is switched off.

Circuit breaker CB1 protects the supply to the photohelic gauge (see Section 1.18). If this breaker trips, the photohelic gauge will not operate.

1.18 iK500 Photohelic switch/gauge (accessory)

The iK500 photohelic switch/gage accessory allow monitoring for loss of extraction from the enclosure, thereby satisfying SEMI S2 requirements. Refer to Section 8 for ordering information.

1.19 Accessories

A number of accessories are available to configure the iK500 system for your specific application. Refer to Section 8 for descriptions of these accessories.

2 TECHNICAL DATA

2.1 General

Dimensions	See Figures 2-1 to 2-3
Inlet and outlet	See Section 2-4
Warm-up time to nominal pumping performance	15 min
Minimum warm-up time to process gas pumping	4 hours
Vacuum system maximum leak-rate	1×10^{-5} mbar.ls ⁻¹ (1×10^{-3} Pa.ls ⁻¹)
Exhaust system maximum leak-rate	1×10^{-5} mbar.ls ⁻¹ (1×10^{-3} Pa.ls ⁻¹)
Ambient operating temperature range	5 to 40 °C
Maximum ambient operating humidity	90% RH
Noise level measured at 1 m from the pump (with enclosure panels fitted)	See Section 2-4
Mass	See Section 2-4
Centre of mass/mass distribution	See Figure 2-3

2.2 Performance

Pumping speed range	See Figure 2-4
Power curves	See Figure 2-5
Peak pumping speed	See Section 2-4
Ultimate vacuum	See Section 2-4
Maximum pressure differential between QMB inlet and outlet	See Section 2-4
Maximum inlet pressure	See Section 2-4

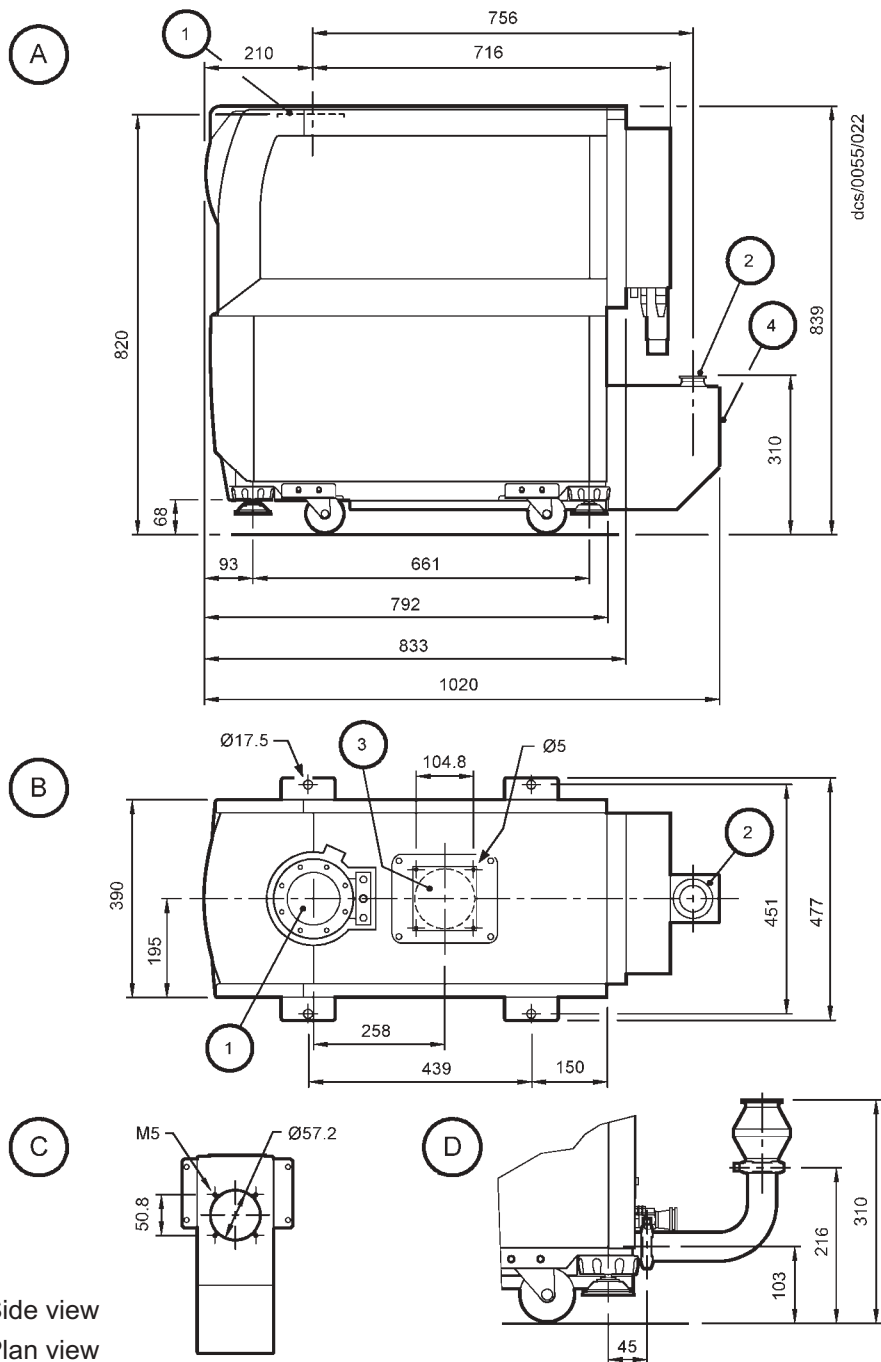
2.3 Temperature control system

HCDP shut-down thermistor	
Type:	Negative Temperature Coefficient thermistor.
Opening temperature	60 ± 3 °C
Closing temperature	50 ± 4 °C
Thermocouples	K type class 1
HCDP and QMB motor-protection thermistors	
Type	Positive temperature coefficient
Reference temperature	150 °C HCDP 160 °C QMB
Compliant with	IEC 34-11 (BS4999 part III)
HCDP water flow-switch	Closed when flow ≥ 2 l.min ⁻¹

2.4 Technical Data

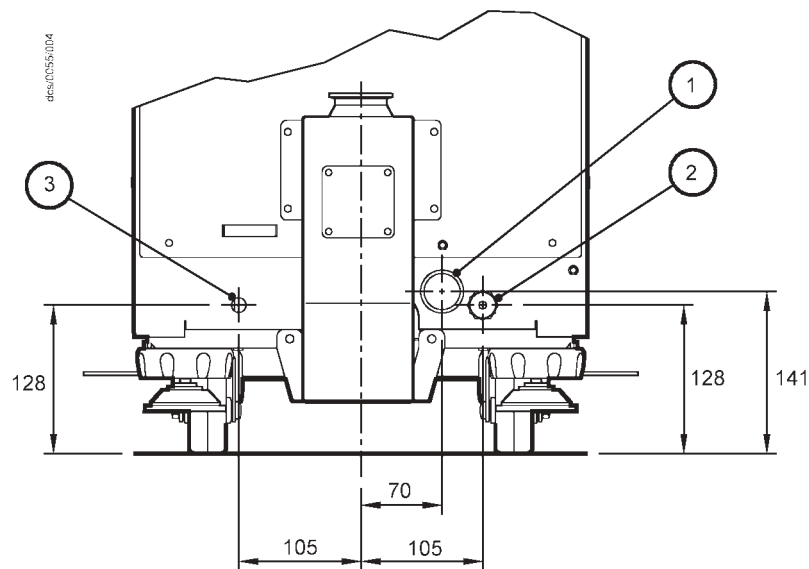
Parameter		Units	iK500
Typical peak pumping speed	50 Hz	m ³ h ⁻¹	350
	60 Hz	m ³ h ⁻¹	450
Typical ultimate vacuum with shaft-seals purge only	50 Hz	mbar	2x10 ⁻³
		Pa	2x10 ⁻¹
	60 Hz	mbar	7x10 ⁻⁴
		Pa	7x10 ⁻²
Maximum pressure differential across QMB pump	50 Hz	mbar	0 - 110
		Pa	0 to 1.1x10 ⁴
	60 Hz	mbar	0 - 110
		Pa	0 to 1.1x10 ⁴
Maximum inlet pressure	50 Hz	mbar	5
		Pa	5x10 ⁻²
	60 Hz	mbar	5
		Pa	5x10 ⁻²
Maximum operating time at maximum inlet pressure	50 Hz	hour	Continuous
	60 Hz	hour	Continuous
Inlet connection		-	ISO100 bolted
Outlet connection		-	NW40
Mass		kg	353
Noise level †		dB(A)	< 69

† Measured at 1 metre from the pump, with enclosure panels fitted.



- A Side view
 - B Plan view
 - C Back view - exhaust enclosure
 - D Outlet dimensions
- 1. Inlet
 - 2. Outlet (as supplied)
 - 3. Main enclosure air-extraction port
 - 4. Exhaust enclosure air-extraction port

Figure 2-1 - iK500 dimensions (mm)



1. Cooling-water outlet
2. Cooling-water inlet
3. Nitrogen inlet

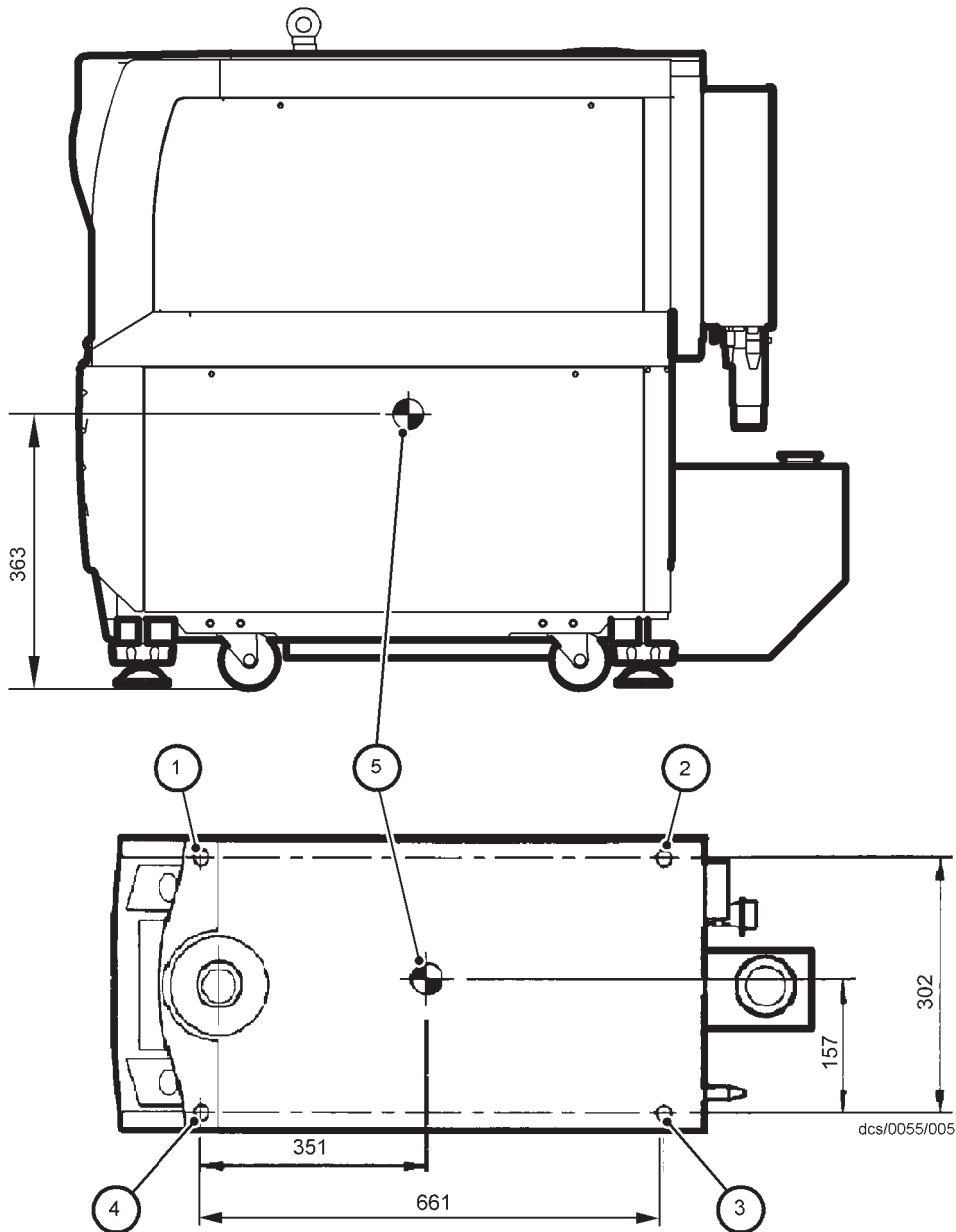
Figure 2-2 - Services connections dimensions (mm)

2.5 Cooling-water supply

Note: Use treated water or non-corrosive industrial water to cool the iK500 system.

Maximum supply pressure	100 psig (6.9 bar, 6.9×10^5 Pa)
Typical pressure differential across supply and return *	
iK500	15 psi (1.03 bar, 1.03×10^5 Pa)
Minimum flow rate required for reliable iK500 system operation	3 lmin^{-1}
Typical heat removed from iK500 system	3kW
Maximum particle size in supply	0.03 mm^2
Water supply quality	
Acidity	6.5 to 8.0
Hardness	< 100 p.p.m
Resistivity	> $1 \text{ k}\Omega\cdot\text{cm}^{-1}$
Solids (turbidity)	< 100 p.p.m

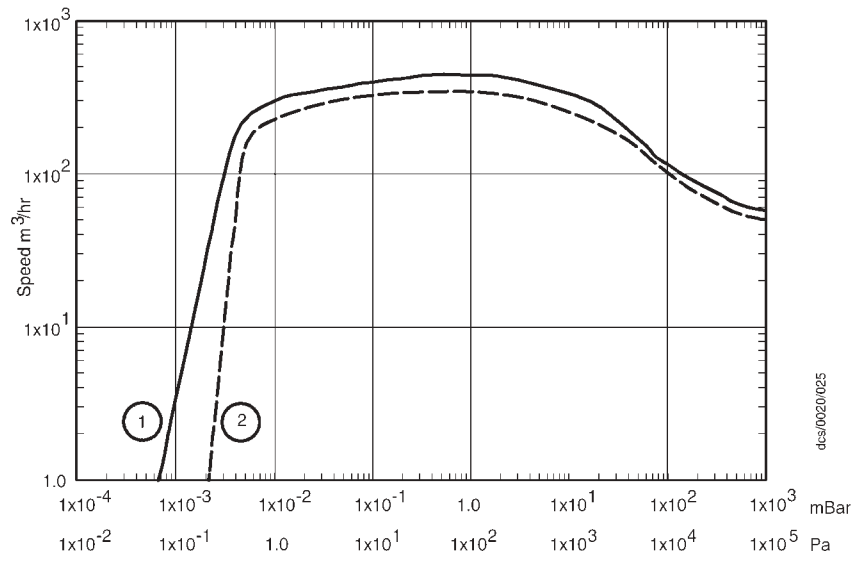
* With cooling-water supply temperature of 20°C and flow rate of $3 \text{ l}\cdot\text{min}^{-1}$.



1. Levelling-foot
2. Levelling-foot
3. Levelling-foot
4. Levelling-foot
5. Centre of mass

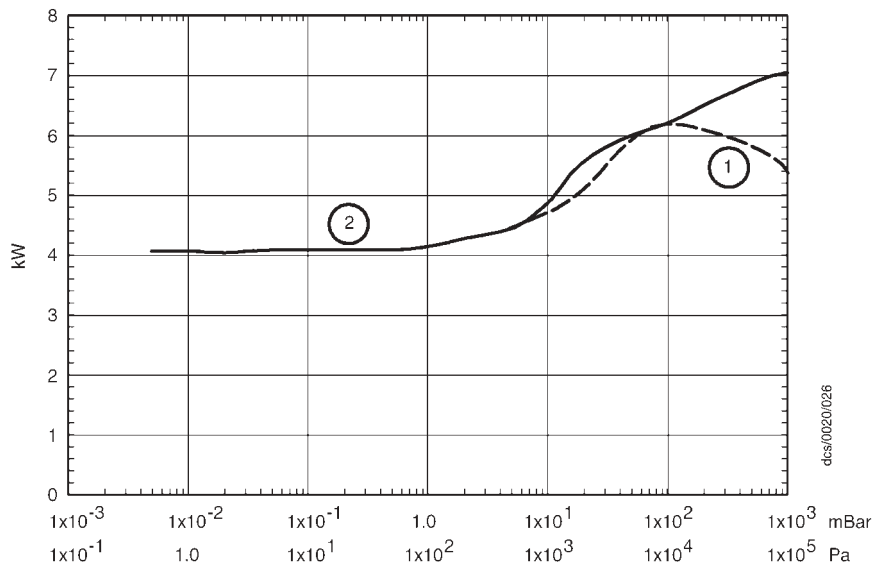
Mass distribution on levelling-feet				
	1	2	3	4
iK500	106 kg	74 kg	96 kg	77 kg

Figure 2-3 - Centres of mass dimensions (mm) and mass distribution



1. 60Hz
2. 50Hz

Figure 2-4 - Typical pumping speeds for iK500: pumping speed against pressure



1. 50 Hz
2. 60 Hz

Figure 2-5- iK500 pump power curves: electrical power input against inlet pressure

2.6 Lubrication

Note: BOC Edwards Material Safety Data Sheets for the oils referenced in the following sections are available on request (Refer to Section 1.1 for contacts).

2.6.1 HCDP pump

Oil charge	0.7 litres (Gearbox)
Recommended perfluoropolyether oils	Fomblin 25/6, Krytox 1525, Drynert 25/6

2.6.2 QMB pump

Oil charge	1.5 litres (coupling cover), 0.125 litres (shaft seal reservoir)
Recommended perfluoropolyether oils	Fomblin YVAC 16/6 or Krytox 1514

2.7 Electrical data

Electrical Supply	
Supply voltage	200-208/380-415 V at 50 Hz, 3-phase 200-208/230/460 V at 60 Hz, 3-phase
Voltage tolerance	±10% (except for 380-415 V at 50 Hz, which are +6% and -6%)
Installation Category	Category 2 (IEC 664)
Fuse types and ratings	
F1 †	30 A, 600 V, Class J
F2 †	30 A, 600 V, Class J
F3 †	30 A, 600 V, Class J
F4 †	20 A, 600 V, Class J
F5 †	20 A, 600 V, Class J
F6 †	20 A, 600 V, Class J
F7	1.6 A, 250 V
F8	1.6 A, 250 V
F9	3.15 A, 250 V
Emergency stop switch rating	24 V a.c./d.c., 5 A max
External emergency stop switch	
Rating	24 V a.c., 5 A
Load	700 mA (inductive)

† These fuse ratings are included for information only. You cannot change these fuses; a BOC Edwards service engineer must change these fuses.

	Volts	Conn	Hz	kW	A	PF
HCDP80	200-208	YY	50	2.9	14.1	0.8
	200-208	YY	60	3.5	14.7	0.88
	230	YY	60	3.5	14.4	0.84
	380-415	Y	50	2.9	7	0.81
	460	Y	60	3.5	7.2	0.84
	Volts	Conn	Hz	kW	A	PF
QMB500	200-208	D	50	2.2	8.7	0.91
	200-208	D	60	2.2	8.8	0.93
	230	D	60	2.2	7.8	0.89
	380-415	Y	50	2.2	5	0.8
	460	Y	60	2.2	4.4	0.8

Table 2-1 - Motor nameplate data

2.8 Gas system

Note: Once you have connected your nitrogen supply and adjusted the nitrogen supply pressure, for optimum performance of the pressure regulator, we recommend that the stability of your nitrogen supply is such that the supply pressure remains within ± 20 psi of the adjusted pressure.

Nitrogen supply pressure range	20 to 100 psig (2.4 to 7.9 bar absolute, 2.4×10^5 to 7.9×10^5 Pa)
Flow rates (with nitrogen supply capacity of 100 slm)	See Table 2-2
Pressure transducer accuracy	± 0.6 psi ($\pm 4.1 \times 10^{-2}$ bar, $\pm 4.1 \times 10^3$ Pa) at 6 psig (1.4 bar absolute, 1.4×10^5 Pa)
Flow transducer accuracy	± 3.0 slm ($\pm 5 \times 10^3$ Pa. s^{-1})

Purge flows		Flow rates	
		slm	Pa.ls ⁻¹
Typical nitrogen flow rates (high gas configuration: factory set)	2/3-interstage purge *	5	8.44 x 10 ³
	3/4-interstage purge *	30	5.06 x 10 ⁴
	Shaft-seals purge	4	6.76 x 10 ³
	Exhaust-purge	5	8.44 x 10 ³
	Maximum total flow without inlet-purge	44	7.44 x 10 ⁴
	Inlet-purge	25	4.22 x 10 ⁴
	Maximum total flow with inlet-purge	44	7.44 x 10 ⁴
Maximum nitrogen flow rates	2/3-interstage purge *	10	1.69 x 10 ⁴
	3/4-interstage purge *	30	5.06 x 10 ⁴
	Shaft-seals purge	10	1.69 x 10 ⁴
	Exhaust-purge	10	1.69 x 10 ⁴
	Maximum total flow without inlet-purge	60	1.01 x 10 ⁵
	Inlet-purge	30	5.06 x 10 ⁴
	Maximum total flow with inlet-purge	60	1.01 x 10 ⁵

* With inlet purge off. When inlet purge is on, these flow rates will be lower.

Table 2-2 - Nitrogen purge flow rates: high gas configuration

2.9 Materials in contact with process gases

Pump, shafts and rotors	Cast iron, steel, SG iron
Internal and external shaft-seals	
HCDP pump	PTFE (polytetrafluoroethylene)
QMB pump	PTFE and fluoroelastomer
HCDP pump nitrogen pipelines	Stainless steel
Gas module nitrogen components (pipelines, manifolds, valves, pressure transducers and so forth)	Brass, stainless steel, aluminium, Viton, nickel.

2.10 Default setpoints

The default setpoints are shown in Tables 2-3 to 2.5. Where there is an 'ADJ' (adjust) entry in these tables, this specifies that the setpoints are usually not used and the default setpoint is preset so that no warning or alarm condition could result from sensor readings. If required you can adjust these 'ADJ' setpoints for your application, so that suitable warnings and alarms can be generated: refer to Section 5.3.

Parameter	Unit	Default setpoint values			
		Low alarm	Low warning	High warning	High alarm
HCDP power consumption	kW	ADJ	0.0	4.0	4.7
QMB power consumption	kW	ADJ	0.0	2.4	2.9

Table 2-3 - Electrics Box default setpoints

Parameter	Unit	Default setpoint values			
		Low alarm	Low warning	High warning	High alarm
HCDP pump temperature	°C	ADJ	ADJ	168	177
HCDP motor cooling-water return temperature	°C	ADJ	ADJ	45	ADJ
QMB booster end cover temperature	°C	ADJ	ADJ	130	ADJ
Exhaust gas temperature	°C	ADJ	ADJ	220	ADJ

Table 2-4- Electronics Module default setpoints

Parameter		Unit †	Default setpoint values			
			Low alarm	Low warning	High warning	High alarm
Total nitrogen flow (high gas configuration: factory set)	Shaft-seals purge on, Exhaust-purge on, 2/3-interstage purge off, 3/4-interstage purge off, Inlet-purge off	slm	ADJ	3	18	ADJ
	Shaft-seal purge on, Exhaust-purge on, 2/3-interstage purge on, 3/4-interstage purge on, Inlet-purge off	slm	ADJ	38.0	59.4	ADJ
	Shaft-seal purge on, Exhaust-purge on, 2/3-interstage purge on, 3/4-interstage purge on, Inlet-purge on	slm	ADJ	38.0	60.0	ADJ
Exhaust pressure		psig	ADJ	ADJ	5.0	8.0
Shaft-seals purge pressure		psig	ADJ	ADJ	12.5	ADJ

† Only slm gas flow values are given in the table, because only slm values can be entered in the Pump Display Terminal. To convert slm values to Pa.ls⁻¹, multiply by (1.013 / 60) × 10⁵.

Table 2-5 - Gas Module default setpoints: high gas configuration

2.11 Connections

Inlet and outlet	See Section 2-4
Electrical supply connector	
Type	Harting HAN-K-4/2
Cable outside diameter range	18 to 27 mm
Maximum conductor cross-sectional area	16 mm ²
Pump Display Module connector	XLR type 4-way
Network communications connector	XLR type 4-way
Exhaust Gas Management interface	6-pin DIN [3-Common; 4-Normally Closed; 5-Normally Open]
iK500 Tool Interface Module connector	XLR type 6-way
Nitrogen supply connector	1/4 inch Tube fitting
Water inlet connector *	3/8 inch BSP male quick-disconnect
Water outlet connector *	3/8 inch BSP female quick-disconnect
Active gauge connector	SCC68 socket
Pump Display Terminal Connector	RJ12

* Connector mating-halves to connect your cooling-water supply and return pipes are supplied with the iK500 system: refer to Section 3.18.

2.12 Tracer gas analysis

iH600 pumping system tracer gas test results are as follows (see Tables 2-6 through 2-7): Note that because the iH600 has a similar size enclosure, these results qualify the iK500 enclosure.

Tracer gas	:	SF ₆
Tracer gas concentration	:	4.00 percent
Tracer gas release rates	:	28 slpm
Tracer gas release point	:	exhaust flange
Tracer release direction	:	toward top of pump
Process gas	:	Nitrogen
Exhaust flow rate (m ³ /h)	:	180.0
Volume of enclosure (m ³)	:	0.253
Free volume of enclosure (m ³)	:	0.157
Air changes per minute	:	19
Enclosure modifications	:	142mm duct connected to top of enclosure

Table 2-6 Test Parameters

Gas Name	Max Flow (slm)	TLV (ppm)	25%TLV (ppm)	Value Obtained (ppm)	ERC	Pass/Fail*
DCS	6	5	1.25	0.03	0.090	Pass
HCL	10	5	1.25	0.03	0.150	Pass
HF	10	3	0.75	0.03	0.150	Pass
NF ₃	15	10	2.50	0.03	0.225	Pass
SiH ₄	6	5	1.25	0.03	0.090	Pass
SF ₆	12	1000	2.50	0.03	0.180	Pass
ClF ₃	1.6	0.1	0.025	0.03	0.024	Pass
TEOS	0.7	20	5	0.03	0.0105	Pass
AsH ₃	0.5	0.05	0.0125	0.03	0.0075	Pass
PH ₃	0.5	0.3	0.075	0.03	0.0075	Pass
WF ₆	0.5	10	2.5	0.03	0.0075	Pass
CO	1	50	12.5	0.03	0.015	Pass
H ₂	2	4000	1000	0.03	0.03	Pass

* Pass indicates acceptable enclosure (satisfies SEMI S2-93 criteria of less than 25.0 percent of the TLV)

Table 2-7 - Test Results

2.13 Disconnect Box

2.13.1 General

Dimensions: 406mm (16.0") x 305mm (12.0") x 203mm (8.0")

Mass: 17kg (38.0lbs)

2.13.2 Operating Conditions

Temperature Range

Operating: +10°C to +40°C (+50°F to +104°F)

Storage: -45°C to +55°C (-113°F to +131°F)

Relative Humidity: 10% to 90%

Maximum Operating Altitude: 2000m

2.13.3 Electrical Data

Input Voltage Range: 200-208/308-415V at 50Hz, 3-phase
200-208/230/460V at 60Hz, 3-phase

Full Load Current Rating: See Table 2-1

Fuse Rating

F1, F2, F3 (Mains Disconnect): 35.0 A

F4, F5 (Primary Fuses): 0.5A

F6 (Secondary Fuse): 3.0A

Main Disconnect Devices Rated: 30.0A, 600V, 300,000 AIC

2.14 Item Numbers

Electrical supply	iK500
460 V, 60 Hz, 3-phase	A53389908
200/208 V, 50 Hz, 3-phase	A53389963
200/208, 60 Hz, 3-phase	A53389964
380/415 V, 50 Hz, 3-phase	A53389946
230 V, 60 Hz, 3-phase	A53389957

3 INSTALLATION

3.1 Safety



WARNING

Obey the safety instructions given below and take note of appropriate precautions. If you do not, you can cause injury to people and damage to equipment.

- A suitably trained and supervised technician must install the iK500 system.
- Ensure that the installation technician is familiar with the safety procedures which relate to the products pumped. Wear the appropriate safety-clothing when you come into contact with contaminated components. Dismantle and clean contaminated components inside a fume-cupboard.
- Do not remove the temporary cover or blanking plate from the iK500 system inlet until you are ready to connect the iK500 system to your vacuum system. Do not operate the iK500 system unless the inlet blanking plate is fitted or the iK500 system is connected to your vacuum system.
- Do not remove the temporary cover or blanking plate from the iK500 system exhaust until you are ready to connect the iK500 system to your exhaust-extraction system. Do not operate the iK500 system unless the exhaust is connected to your exhaust-extraction system.
- Vent and purge the process system (if the iK500 system is to replace an existing pumping system) with nitrogen for 15 minutes before you start installation work.
- Disconnect the other components in the process system from the electrical supply so that they cannot be operated accidentally.
- Do not reuse any 'O' ring or 'O' ring assembly and do not allow debris to get into the iK500 system during installation.
- Wipe up any water or oil spilt during installation to avoid possible risk of slips.
- Route and secure cables, hoses and pipe-work during installation to avoid possible risk of trips.
- Obey all national and local rules and safety regulations when you install the iK500 system.
- Consult BOC Edwards publication P300-20-000 (Vacuum Pump and Vacuum System Safety) before you pump hazardous materials. This publication is available on request: contact your supplier or BOC Edwards.

3.2 Installation checklist

The operations required to install the iK500 system and the sections of this instruction manual which describe those operations are shown in Table 3-1.


Installation operation	Section
Unpack and inspect	3.3
Remove the enclosure panels	3.4
Reconfigure the nitrogen and water connections (if required)	3.5
Locate the iK500 system	3.6
Check and fill the pump oil-level(s)	3.7
Install or replace the Pump Display Terminal and optional accessories (if necessary)	3.8
Install the Pump Display Terminal	3.8.1
Install optional accessories	3.8.2
Connect the iK500 inlet to your vacuum system	3.9
Connect the iK500 exhaust outlet to your exhaust extraction system	3.10
Connect to your factory extraction system (optional)	3.11
Connect the nitrogen supply	3.12
Leak test the system	3.13
Install additional safety equipment (optional)	3.14
Connect to your emergency stop circuit (optional)	3.15
Electrical supply and RF earth (ground) connections	3.16
Reconfigure the iK500 system for your electrical supply (if necessary)	3.16.1
Reconfigure the pump(s) for your electrical supply (if necessary)	3.16.2
Connect the electrical supply to the iK500 system	3.16.3
Connect an additional RF earth (optional)	3.16.4
Refit the enclosure panels	3.17
Connect the cooling-water pipelines	3.18
Adjust the interstage purge flow rates if necessary	3.19
Commission the iK system	3.20
Switch on an iK500 system	3.20.1
Install Disconnect Box (accessory)	3.21
Unpack and Inspect	3.21.1
Mounting	3.21.2
Electrical Installation	3.21.3
Main Electrical Supply	3.21.4
Cable Connections	3.21.5
Install Photohelic Switch/Gauge (accessory)	3.22
Unpack and Inspect	3.22.1

Table 3-1 - Installation checklist

Installation operation	Section
Mounting	3.22.2
Piping Connections	3.22.3
Cable Connections	3.22.4

Table 3-1 - Installation checklist (continued)

3.3 Unpack and inspect



WARNING

You must use suitable lifting equipment to move the iK500 system. It is too heavy to lift by hand.

The iK500 system is supplied sealed in a foil bag. To prevent contamination of the iK500 system, before you unpack and inspect the iK500 system we recommend that you move the pallet as close as possible to the clean area in which you will install the system. Remove the foil bag carefully; use the bag as a dust cover while you wheel the iK500 system to its final operating position.

Use the following procedure to unpack and inspect the iK500 system.

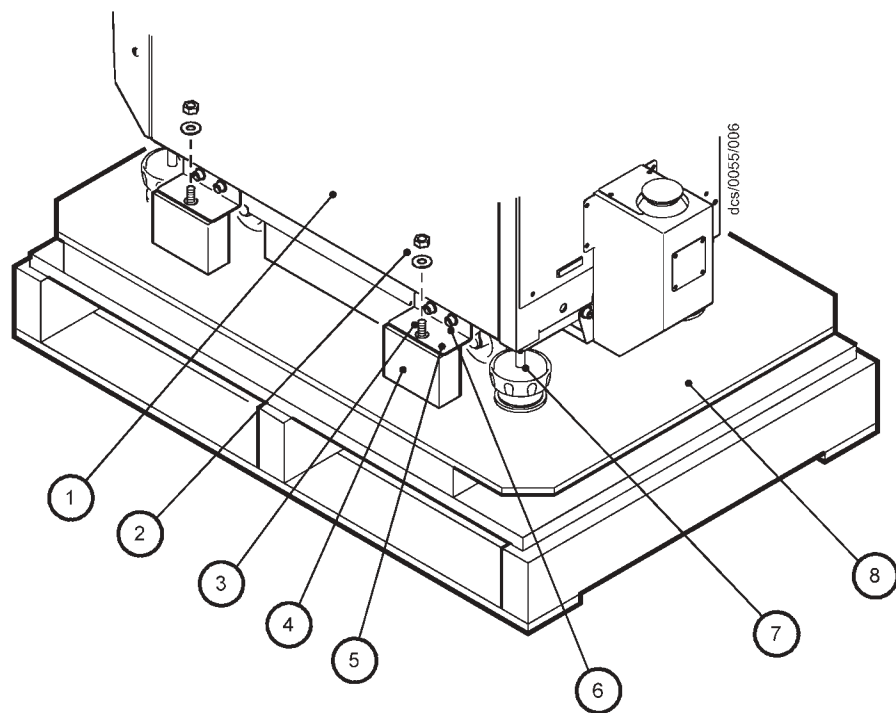
1. Place the pallet in a convenient position with a fork-lift truck or a pallet truck.
2. Open the cardboard box.
3. Remove the staples which secure the cardboard box to the pallet, then remove the cardboard box. Open the top of the foil bag which encloses the iK500 system.
4. Check that you have received the items listed in Table 3-2. If any of these is missing, notify your supplier within three days.

Qty	Description	Check (✓)
1	iK500 dry pumping system	<input type="checkbox"/>
1	Pump Display Terminal	<input type="checkbox"/>
Fitting-kit which contains the following:		
1	Cooling-water quick-release connectors (pair)	<input type="checkbox"/>
1	NW40 trapped 'O' ring	<input type="checkbox"/>
1	NW40 clamp	<input type="checkbox"/>
1	Nitrogen pipeline fitting	<input type="checkbox"/>
1	Module connector terminator plug	<input type="checkbox"/>
1	Emergency stop switch guard *	<input type="checkbox"/>
1	Electrical supply connector	<input type="checkbox"/>
3	1 Kg Fomblin 16/6	<input type="checkbox"/>
1	Lifting Bolt Hole Plug	<input type="checkbox"/>

* If required, fit this over the emergency stop switch to prevent inadvertent operation of the switch.

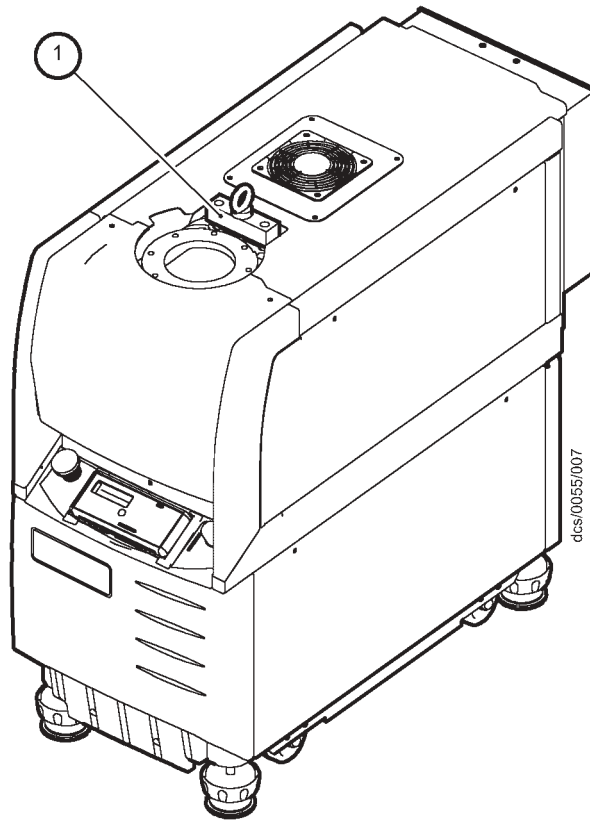
Table 3-2 - Checklist of components

5. Remove the screws which secure the wooden stabiliser to the QMB pump-inlet, remove the stabiliser, then refit the screws to the QMB pump-inlet blanking plate. Retain the stabiliser for future use.
6. Refer to Figure 3-1. Remove the nut and washer (2) which secures each of the four seismic brackets (5) to the blocks (4) on the pallet. Retain the nuts and washers for future use.
7. Refer to Figure 3-2. Use suitable lifting-equipment attached to the lifting bolt (1) to remove the iK500 system from its pallet. Do not try to lift the iK500 system by hand (see Section 2 for the mass of the iK500 system).
8. Inspect the iK500 system. If the iK500 system or any other item is damaged, notify your supplier and the carrier in writing within three days; state the Item Number of the iK500 system together with your order number and your supplier's invoice number. Retain all packing materials for inspection. Do not use the iK500 system if it is damaged.
9. If the iK500 system is not to be used immediately, replace the packing materials. Store the iK500 system in suitable conditions as described in Section 7. If you will use the iK500 system immediately, continue at Step 10.



- | | |
|-------------------|------------------------------|
| 1. iK500 system | 5. Seismic Bracket |
| 2. Nut and washer | 6. Cap-head screw and washer |
| 3. Stud | 7. Levelling foot |
| 4. Block | 8. Pallet |

Figure 3-1 - Remove the iK500 system from the pallet



1. Lifting-bolt

Figure 3-2 - Lifting-bolt positions

10. Refer to Figure 3-1. If you do not want to use the seismic brackets to prevent inadvertent movement of the iK500 system (see Section 3.6), undo and remove the two cap-head screws and washers (6) which secure each of the four brackets (5) to the sides of the iK500 system, then remove the brackets. Retain the brackets, cap-head screws and washers for future use.

3.4 Remove the enclosure panels

1. Refer to Figure 3-3. Remove the QMB right-hand side panel from the iK500 system:
 - Place your hand against the top of the right-hand side panel (3) to support it and use a flat-head screwdriver to release the two quarter-turn catches (2).
 - Swing the top of the panel out slightly and lift out the panel so that the slots in the bottom of the panel disengage from the pins (5) on the frame.
 - Fully remove the panel and place it in a safe location.
2. Remove the QMB left-hand side panel: use the method in Step 1 above.
3. Remove the HCDP right-hand and left-hand side panels: use the method in Step 1 above.
4. Remove the cover plate (8).

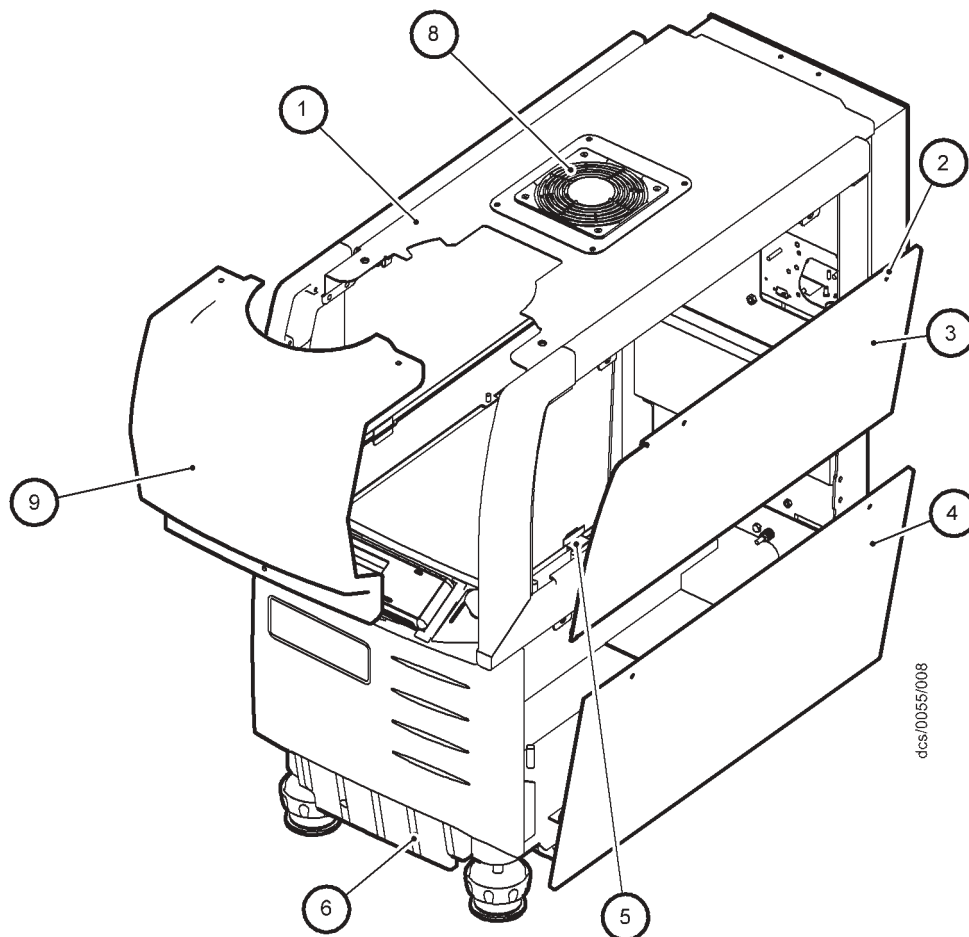
3.5 Reconfigure the nitrogen and/or water connections (if required)

CAUTION

Ensure that the cooling-water system of your iH system is correctly configured for your electrical supply frequency. If it is incorrectly set at 50Hz, the system will run above optimum operating temperature. If it is incorrectly set at 60 Hz, the system will run below optimum operating temperature.

As supplied, the nitrogen and cooling-water connections are at the rear of the iK500 system (as shown in Figure 1-5) and the cooling water is configured for operation at 60Hz (as shown in Fig 3-4). If required, you can reconfigure the iK500 system so that the nitrogen and/or cooling-water connections are at the front of the iK500 system. (see point 1 below) or for operation at 50Hz (see point 2 below).


1. You will need an Alternative Nitrogen and Cooling-Water Connections Kit if you want to reconfigure the nitrogen and/or cooling-water connections (see Section 8). Reconfigure the connections as described in the instruction manual supplied with the kit.
2. See Figure 3-4. If the iK500 system will be operating at 50Hz, switch the positions of the control plug (2) and the blanking plug (3) in the HCDP headplate manifold (1) to ensure operation at optimal temperature. The control plug (marked with and 'X') should now be in the 50Hz port and the blanking plug in the 60Hz port.



1. Top panel
2. Catches
3. Right-hand side panel (upper)
4. Right-hand side panel (lower)
5. Pins
6. Screws (2 off)
7. Lower cover
8. Cover plate
9. Front cover

Figure 3-3 - Remove/refit the enclosure panels

3.6 Locate the iK500 system

	<p style="text-align: center;">WARNING</p> <p style="text-align: center;">You must use suitable lifting equipment to move the iK500 system. It is too heavy to lift by hand.</p>
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Use the following procedure to locate the iK500 system in its operating position. The iK500 system must be located on a firm, level surface.

1. Use suitable lifting equipment attached to the lifting bolt to move the iK500 system close to its final operating position.
2. Refer to Figure 3-6. Remove the nuts and washers (4) which secure the four transit brackets (2) to the vibration isolators (3), then remove the transit brackets.
3. Wheel the iK500 system on its castors to move it into its operating position.
4. Adjust the levelling feet to make sure that the iK500 system is level and is not supported by the castors.
5. If you want to secure the iK500 in place to prevent inadvertent movement (for example, during an earthquake), take note of the following:
 - the iK500 system can be secured to the floor by fitting suitable bolts or studs (not supplied) through the 17.5mm hole in the seismic brackets (Figure 3-1, item 5).
 - if vibration to the floor is a concern, suitable vibration isolators (not supplied) should be fitted between the seismic brackets and the bolt or stud.

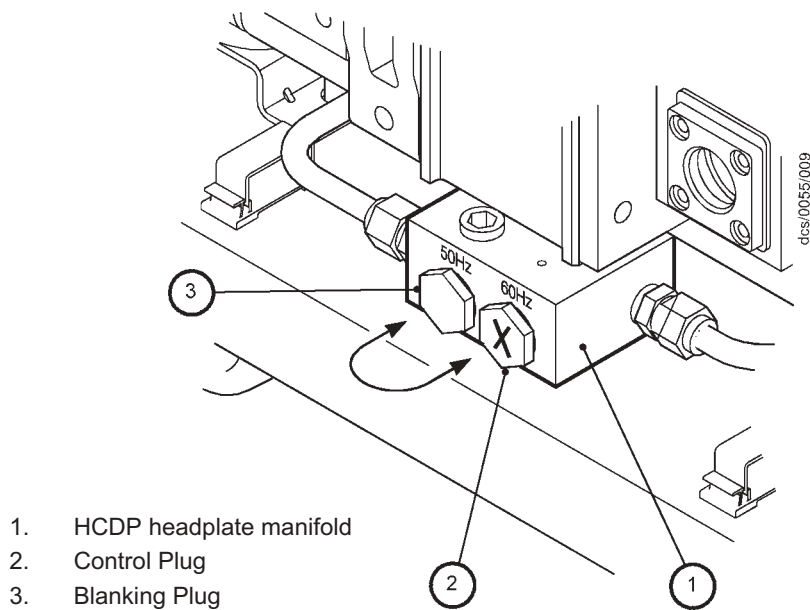


Figure 3-4 - HCDP headplate cooling-water manifold (as supplied)

- although the iK500 is supplied with four seismic brackets, two brackets are capable of protecting the system during an earthquake. The system can therefore be secured as shown in Figure 3-7, for example, to reduce the effective system footprint if required.
 - if all four seismic brackets are to be used, ensure that the bolt spacing is adequate for the floor strength and loads anticipated.
6. If preferred, the lifting bolt can be removed and replaced with the lifting bolt hole plug supplied with the iK500 system.

3.7 Check and fill the pump oil-level(s)

CAUTION

Ensure that the oil-levels in the HCDP pump and the QMB pump are correct. If a pump oil-level is incorrect, pump performance may be affected and the pump may be damaged.

In the iK500 system the HCDP pump is supplied filled with oil, but the QMB is not.

3.7.1 HCDP

Refer to Figure 3-5, detail B. Check that the oil-level is between the MAX and MIN marks on the bezel of the HCDP oil-level sight-glass:

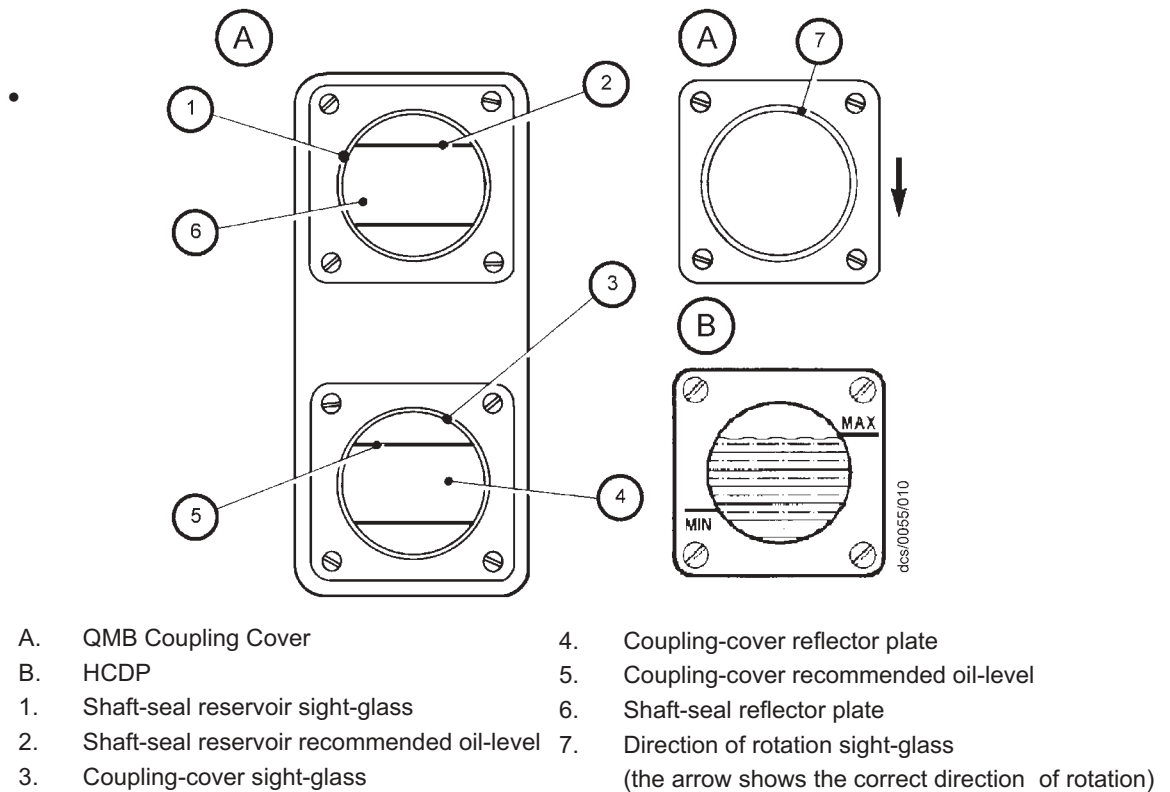


Figure 3-5 - Sight-glasses

- If the oil-level is above the MAX mark, drain excess oil from the pump as described in Section 6.9 until the oil-level is correct.
- If the oil-level is below the MIN mark, fill the pump with PFPE oil, Fomblin 25/6, Krytox 1525 or Drynet 25/6, until the oil-level is correct, as described in Section 6.8.

3.7.2 QMB500

3.7.2.1 Coupling-cover

We recommend that the coupling-cover oil-level is maintained at the recommended oil-level shown in Figure 3-5, item 5; if the oil-level is above or below the recommended oil-level, the performance of the pump may be affected. Do not allow the coupling-cover oil-level to fall below the bottom of the reflector plate (Figure 3-5, item 4) or the pump may be damaged.

1. Remove the coupling-cover oil filler-plug (Figure 1-3, item 3).
2. Refer to Figure 3-5. Fill the coupling-cover with PFPE oil, Fomblin YVAC 16/6 or Krytox 1514, until the oil-level reaches the recommended oil-level (5) at the top of the reflector plate (4) in the coupling-cover sight-glass (3).
3. Refit the coupling-cover oil filler-plug.

3.7.2.2 Shaft-seal reservoir

	<p>WARNING</p> <p>Ensure that the correct vented filler-plug is replaced in the shaft-seal reservoir. If you use a non-vented plug, the reservoir will be pressurised and the oil sight-glass may fracture.</p>
---	--

We recommend that you fill the shaft-seal reservoir so that the oil-level is at the recommended oil-level, shown in Figure 3-5, item 2. You can operate the pump as long as the oil-level is above the bottom of the reflector plate. Do not allow the shaft-seal oil-level to fall below the bottom of the reflector plate or the pump may be damaged. You must use the same oil you used to fill the coupling-cover.

1. Remove the shaft-seal reservoir vented oil filler-plug (Figure 1-3, item 2).
2. Refer to Figure 3-5. Fill the shaft-seal reservoir with PFPE oil, Fomblin YVAC 16/6 or Krytox 1514, until the oil-level is at the recommended oil-level (2) at the top of the reflector plate (6).
3. Refit the vented oil filler-plug.

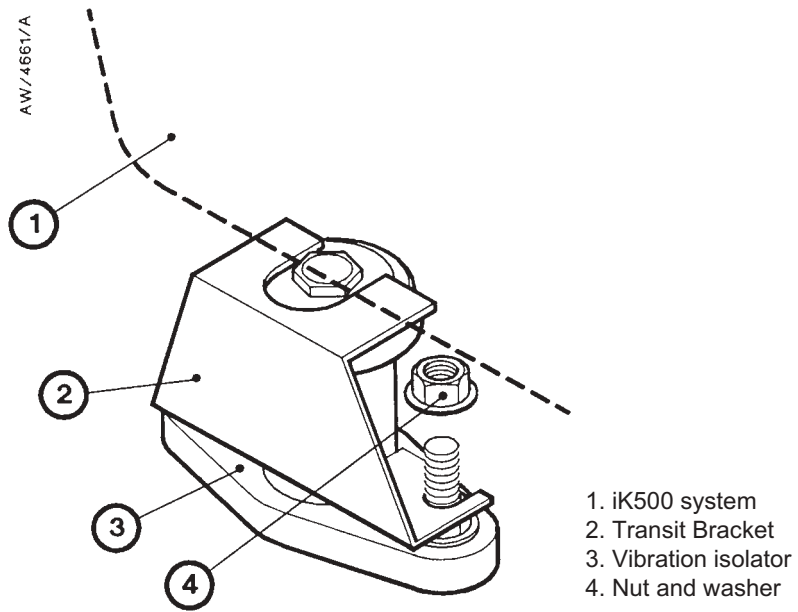


Figure 3-6 - Remove the isolator transit brackets

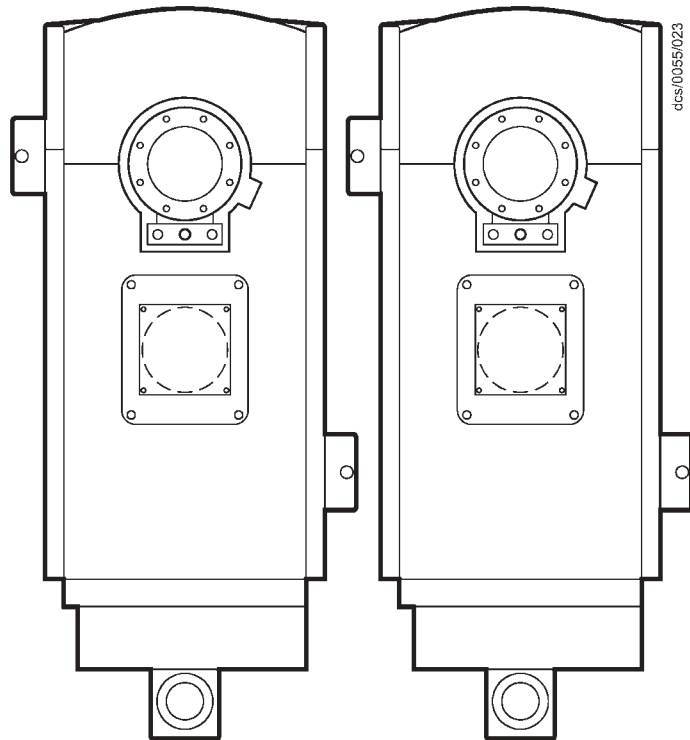


Figure 3-7 - System arrangement to reduce effective footprint (if required)

3.8 Install or replace the Pump Display Terminal and optional accessories (if necessary)

3.8.1 Install the Pump Display Terminal

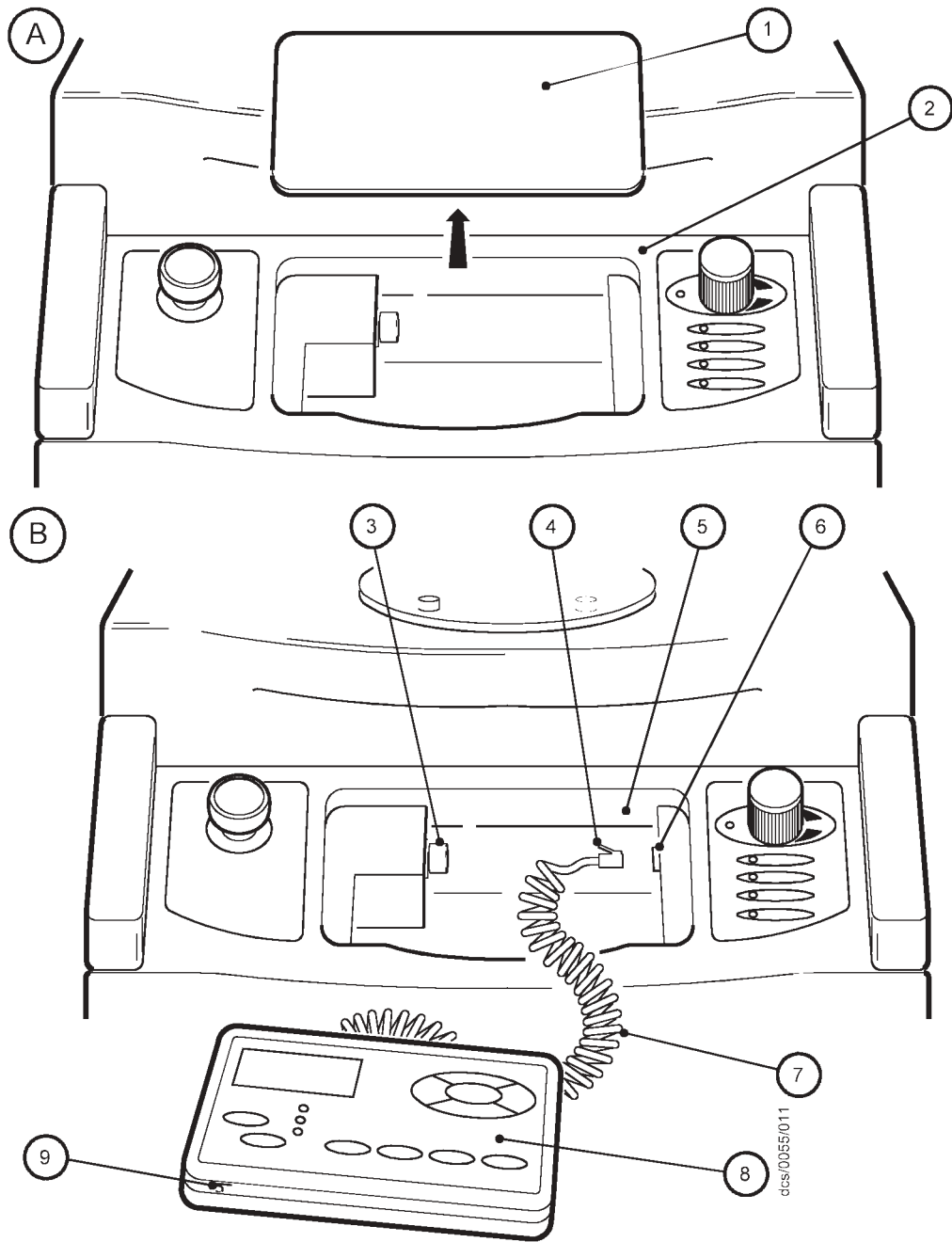
CAUTION

It is imperative that the Pump Display Terminal is stored in the recess after installation or use. Placing it in a hot surface such as on top of the enclosure may adversely affect the long-term reliability of the terminal.

1. Unpack and inspect the Pump Display Terminal.
2. Refer to Figure 3-8. Remove the blanking panel (1) from the dashboard(2).
3. Fit the connector (4) on the end of the cable (7) to the Pump Display Terminal connector (6) in the recess (5) in the dashboard.

Note: The Pump Display Terminal connector (6) is intended for use by the Pump Display Terminal only and should not be mistaken for a Portable Personal Computer port.

4. Place the coiled cable (7) in the recess, then place the Pump Display Terminal (8) in position in the recess (5).



- A Remove the blanking panel
- B Fit the Pump Display Terminal

- | | |
|----------------------------------|------------------------------------|
| 1. Blanking panel | 5. Recess |
| 2. Dashboard | 6. Pump Display Terminal connector |
| 3. Pump Display Module connector | 7. Cable |
| 4. Connector | 8. Pump Display Terminal |
| | 9. Viewing angle adjuster |

Figure 3-8 - Fit Pump Display Terminal

3.8.2 Install optional accessories

Note: Some accessories can only be factory fitted (see Section 8): you will have ordered these accessories when you ordered your iK500 system, and the accessories will be supplied fitted to your iK500 system.

Install optional accessories (listed in Section 8) as described in the instructions supplied with the accessory.

3.9 Connect the iK500 inlet to your vacuum system

Note: If required (that is, if you will use the iK500 system in an area subject to high RF (radiofrequency) emissions), connect the end of the iK500 earth (ground) cable to one of the bolts that you use to connect the inlet-flange of the iK500 system to your process system. See Section 3.16.4 for more information.

When you connect your iK500 system to your vacuum system, take note of the following:

- To get the best pumping speed, ensure that the pipeline which connects the vacuum system to the iK500 system is the minimum length possible and has an internal diameter not less than the iK500 system inlet-port.
- Ensure that all components in the vacuum pipeline have a maximum pressure rating which is greater than the highest pressure that can be generated in your system.
- Incorporate flexible pipelines in the vacuum pipeline to reduce the transmission of vibration and to prevent loading of coupling-joints. We recommend that you use BOC Edwards braided flexible pipelines.
- Adequately support vacuum pipelines to prevent the transmission of stress to pipeline coupling-joints.
- On very dusty applications, use a low-impedance inlet-filter to minimise damage to the pump.
- Incorporate a pressure gauge in the inlet pipeline, so that you determine that the iK500 system operates correctly. You can fit an Active Gauge Connection Kit accessory (see Section 8.4.2) for this purpose.
- You must be able to isolate the iK500 system inlet from the atmosphere and from your vacuum system if you have pumped or produced corrosive chemicals.

Use the following procedure to connect the inlet of the iK500 system to your vacuum inlet pipeline:

1. Remove the temporary cover or blanking plate from the inlet of the iK500 system. Retain the nuts, bolts, washers and blanking plate for future use. Retain the temporary cover for future use on non-contaminated pumps only.
2. Use the 'O' ring supplied and connect the inlet-flange of the iK500 system to your vacuum system.

3.10 Connect the iK500 exhaust outlet to your exhaust-extraction system



WARNING

Pipe the exhaust to a suitable treatment plant to prevent the discharge of dangerous gases or vapours to the surrounding atmosphere.



WARNING

Do not operate the iK500 system with the exhaust pipeline blocked. If the exhaust pipeline is blocked, the iK500 system can generate exhaust pipeline pressures up to 7 bar (7×10^5 Pa).

CAUTION

Use a catchpot to prevent the drainage of condensate back into the iK500 system. Condensate which drains back into the iK500 system could damage the HCDP pump.

When you connect to your exhaust-extraction system, take note of the following:

- Ensure that all components in the exhaust pipeline have a maximum pressure rating which is greater than the highest pressure that can be generated in your system.
- Incorporate flexible pipelines in the exhaust pipeline to reduce the transmission of vibration and to prevent loading of coupling-joints. We recommend that you use BOC Edwards braided flexible pipelines.
- You must be able to isolate the exhaust-outlet from the atmosphere if you have pumped or produced corrosive chemicals.
- Adequately support exhaust pipelines to prevent the transmission of stress to pipeline coupling-joints.

Use the following procedure to connect the iK500 system to your exhaust-extraction system. Refer to Figure 1-1:

1. If the check valve (14) is not required on your application:
 - remove the exhaust enclosure (23) by removing the screws connecting to the rear bulkhead cover, drip tray (24) and exhaust enclosure top plate. (See also Figure 3-18)
 - undo and remove the clamp and 'O' ring (19 and 18) which secures the check valve to the elbow (17).
 - retain the check valve for possible future use.

2. If neither the check valve (14) nor elbow (17) is required on your application, or if the elbow is required in a different orientation:
 - remove the exhaust enclosure (23) by removing the screws connecting to the rear bulkhead cover, drip tray (24) and exhaust enclosure top plate. (See also Figure 3-18)
 - remove the clamps insulation jacket (21) and retain.
 - undo, or remove, the clamped 'O' ring that secures the elbow (17) to the exhaust pipe (15).
 - reposition, or remove, the elbow (retain for possible future use if removed).
3. Remove the temporary cover or blanking plate from the exhaust outlet. Retain blanking plate for future use. Retain temporary cover for future use on non-contaminated pumps only. Use the NW40 trapped 'O' ring and clamp supplied to connect the exhaust outlet on the check valve (14), or elbow (17), or exhaust pipe (15), to your extraction system.
4. If the check valve or elbow was removed or reoriented:
 - refit the clamps insulation jacket (if removed) on the NW40 joint to your exhaust extraction system. Use Fig. 6-3 as a guide.
 - refit the exhaust enclosure (if possible) using the the screws connecting to the rear bulkhead cover, drip tray and exhaust enclosure top plate. (See also Figure 3-18).

3.11 Connect to your factory extraction system (optional)

As supplied, the temperature control system fitted is sufficient to maintain the iK500 system at the correct operating temperature; you do not need to connect an air-extraction system to the iK500 system. However, if required you can connect your factory extraction system to the air-extraction port on the top of the main enclosure and the back of the exhaust enclosure (see Figure 2-1). Note that the iK500 system is supplied with a finger-guard fitted over the main enclosure port and a cover (Figure 3-18, item 6) over the exhaust extraction port.

3.12 Connect the nitrogen supply

CAUTION

Ensure that your nitrogen supply conforms to the requirements given in Section 2. If it does not, the flow sensors may not operate correctly, the gas pipelines may become blocked or the iK500 system may be damaged.

Connect your nitrogen supply to the iK500 system through the nitrogen inlet on the rear of the iK500 system (Figure 1-5, item 4).

Use rigid metal supply pipelines (such as stainless steel). We recommend that the nitrogen supply pipeline to the iK500 system has an outside diameter of $\frac{1}{4}$ inch, and that the pipeline is designed and constructed so that large pressure drops are not introduced into the nitrogen supply.

Use the Swagelok connectors in the fitting-kit to connect your nitrogen pipeline to the iK500 system: use the Swagelok connectors as described in Section 6.2.

3.13 Leak test the system



WARNING

Leak-test the system after installation and maintenance and seal any leaks found to prevent leakage of dangerous substances out of the system and leakage of air into the system.

Note: If you need further information on leak testing, contact your supplier or BOC Edwards for advice.

Leak-test the system after installation and seal any leaks found. Dangerous substances which leak from the system will be dangerous to people and there may be a danger of explosion if air leaks into the system.

Use a pump down test with helium to leak test the pump. We recommend that the leak rate is 1×10^{-5} mbar.ls⁻¹ (1×10^{-3} Pa.ls⁻¹) helium or less for the complete system, or 1×10^{-6} mbar.ls⁻¹ (1×10^{-4} Pa.ls⁻¹) helium or less for any individual leak.

The iK500 system is supplied with a blanked leak-test port, as shown in Figure 3-9. To connect to this port:

1. Refer to Figure 3-9. Remove the $\frac{3}{8}$ inch BSP blanking plug from the port (5).
2. Fit a suitable NW25 klein adaptor and 'O' ring and (if required) an elbow to the port, then connect your leak test equipment to the adaptor or elbow.

3.14 Install additional safety equipment (optional)



WARNING

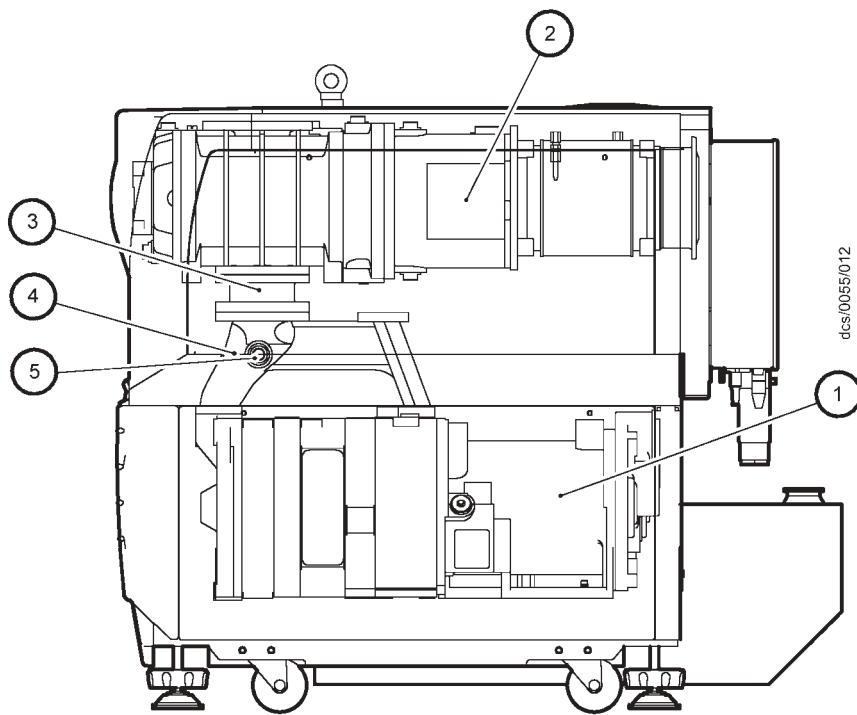
If your Process Tool/control system needs to know the total flow rate of nitrogen to the iK500 system for safety reasons, install suitable measurement equipment in the nitrogen supply pipeline.



WARNING

If you use the nitrogen purges to dilute dangerous gases to a safe level, ensure that the system shuts down if the nitrogen supply to the iK500 system fails.

If the sensors or microprocessor fail, the total flow rate of nitrogen displayed or output by the iK500 system may be incorrect. If you need to know the total flow rate of nitrogen to the HCDP pump for safety reasons, you should therefore fit suitable measurement equipment in the nitrogen supply pipeline. If you fit a rotameter, ensure that it is suitable for use with nitrogen and that it is correctly calibrated.



- | | |
|----------------|-----------------------------|
| 1. HCDP pump | 4. Support manifold |
| 2. QMB pump | 5. Leak-test port (blanked) |
| 3. Spool piece | |

Figure 3-9 - Leak-test port positions

If the nitrogen supply to the iK500 system fails, a warning message will be shown on the Pump Display Terminal and will be sent to the Interface Module(s) connected to the iK500 system. Ensure that your installation is configured so that it remains safe if there is a failure of the nitrogen supply to the iK500 system.

If an alarm condition is detected (and the iK500 system is not configured to 'run till crash': see Section 5.11) the iK500 system will shut down automatically. You must ensure that your installation remains safe if the iK500 system shuts down automatically.

3.15 Connect to your emergency stop circuit (optional)

Note: If you do not connect to your own control equipment, you must fit the iK500 Tool Interface Module plug supplied to the iK Tool Interface Module connector on the rear of the iK500 system (Figure 1-5, item 8). If you do not, you will not be able to operate the iK500 system.

If required, you can connect your own control equipment to the iK500 system to shut down the iK500 system in an emergency. Use the following procedure

1. Remove the link between pins 1 and 2 of the iK500 Tool Interface Module connector plug supplied.
2. Connect a suitable cable to the plug; Table 3-3 shows the use of the pins in the plug.
3. Refer to Figure 1-5. Fit the plug to the iK Tool Interface Module connector (8) on the rear of the iK500 system.

Pin(s)	Use
1 and 2	Linked as supplied. Remove the link and connect these pins to your normally-closed, isolated external emergency stop circuit.
3 and 4	Isolated auxiliary contacts of the emergency stop switch on the Electrics Box.
5	24 V a.c. continuous output; maximum current 625 mA
6	0 V return

Table 3-3 - Pins in the iK500 Tool Interface Module connector plug

dc5/0055/018

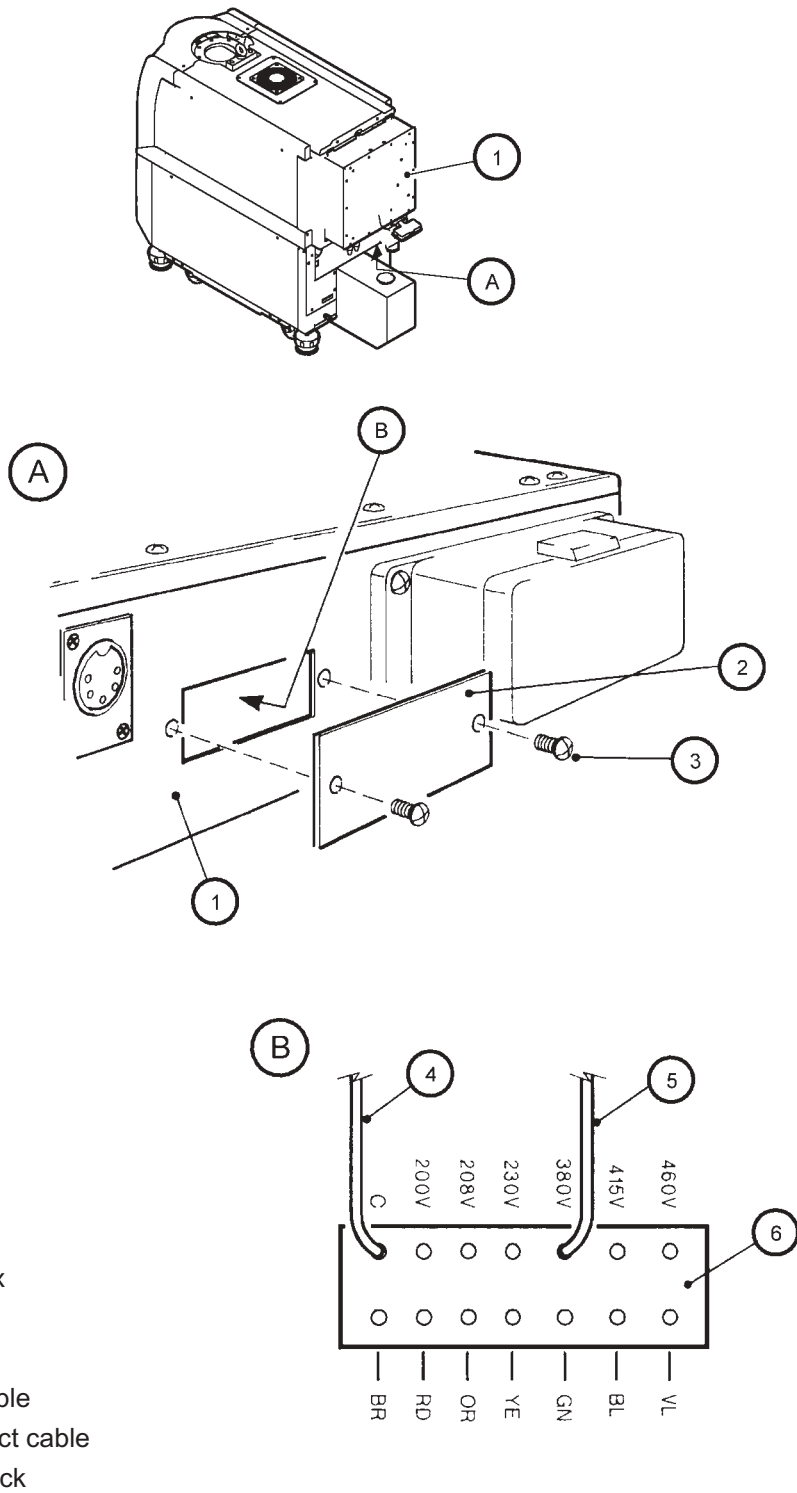


Figure 3-10 - Reconfigure the iK500 system for your electrical supply

3.16 Electrical supply and RF earth (ground) connections

3.16.1 Reconfigure the iK500 system for your electrical supply (if necessary)

CAUTION

Ensure that the cooling-water system of your iH system is correctly configured for your electrical supply frequency. If it is incorrectly set at 50Hz, the system will run above optimum operating temperature. If it is incorrectly set at 60 Hz, the system will run below optimum operating temperature.

Your iK500 system will be supplied correctly configured for your electrical supply; the Item Number of the iK500 system (shown on the rating plate: Figure 3-11, item 1) specifies how the system is configured: refer to Section 2.11.

If you want to use an iK500 system with a different electrical supply, ensure that the correct transformer primary tapping is selected before you connect the electrical supply to the iK system; refer to Figure 3-10 and use the following procedure:

1. Undo the screws (3) which secure the cover (2) to the Electrics Box (1) and remove the cover.
2. Ensure that the common cable (4) is correctly connected to the common terminal on the terminal-block (6).
3. Ensure that the voltage select cable (5) is connected to the correct voltage terminal of the terminal-block (6) for your electrical supply.
4. Refit the cover (2) and secure with the two screws (3).

3.16.2 Reconfigure the pump(s) for your electrical supply (if necessary)

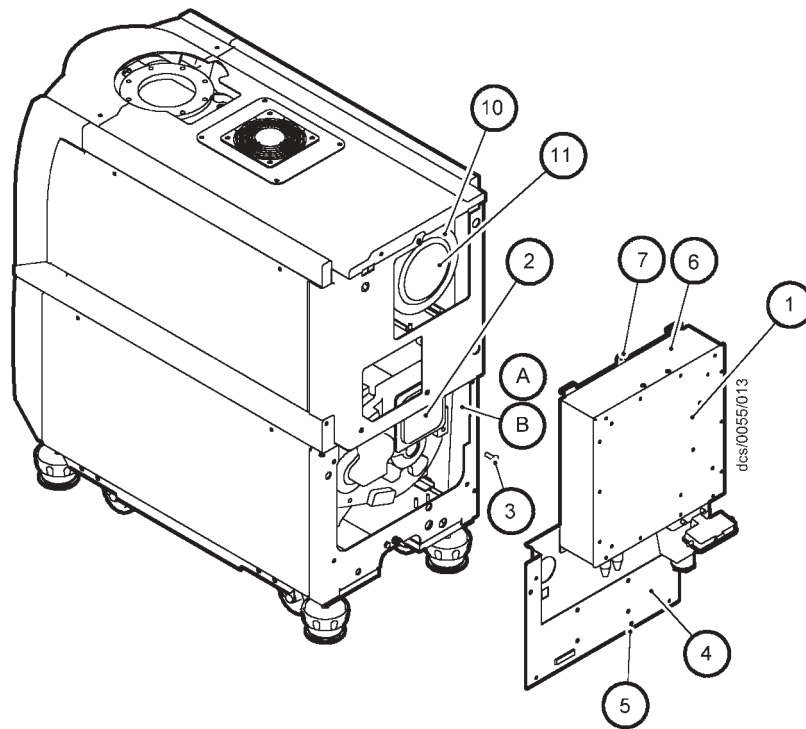
CAUTION

Ensure that the cooling-water system of your iH system is correctly configured for your electrical supply frequency. If it is incorrectly set at 50Hz, the system will run above optimum operating temperature. If it is incorrectly set at 60 Hz, the system will run below optimum operating temperature.

Your iK500 system will be supplied correctly configured for your electrical supply; the Item Number of the iK500 system (shown on the rating plate: Figure 3-11, item 1) specifies how the system is configured: refer to Section 2.11.

If you want to use an iK500 system with a different electrical supply, use the following procedure:

1. Refer to Figure 3-11. Undo and remove the six screws (5) which secure the blanking plate (4) over the HCDP pump-motor, and remove the blanking plate.



- A High voltage configuration HCDP
- B Low voltage configuration HCDP

1. Rating plate (on Electrics Box)
2. Pump-motor terminal-box cover
3. Screws (4 off)
4. Blanking plate
5. Screws
6. Electrics Box
7. Screws (4 off)
8. Pump-motor terminal-box
9. Links (HCDP)
10. Screws (4 off)
11. Booster motor control terminal box cover

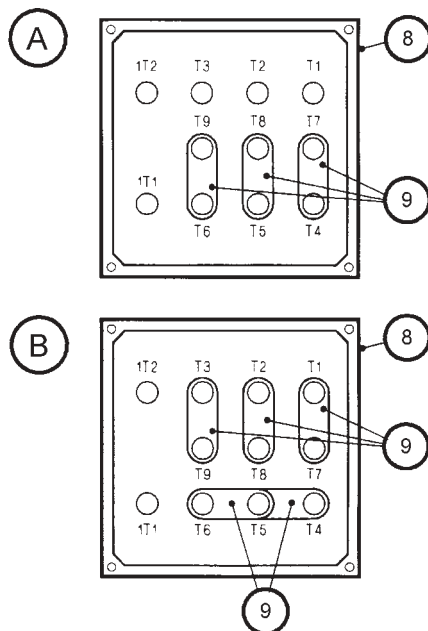
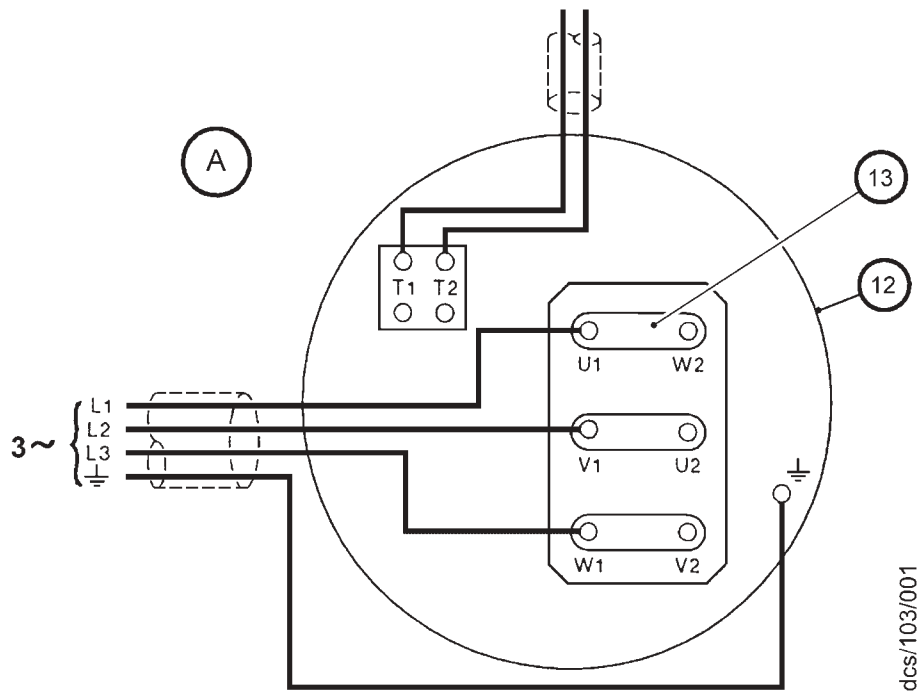
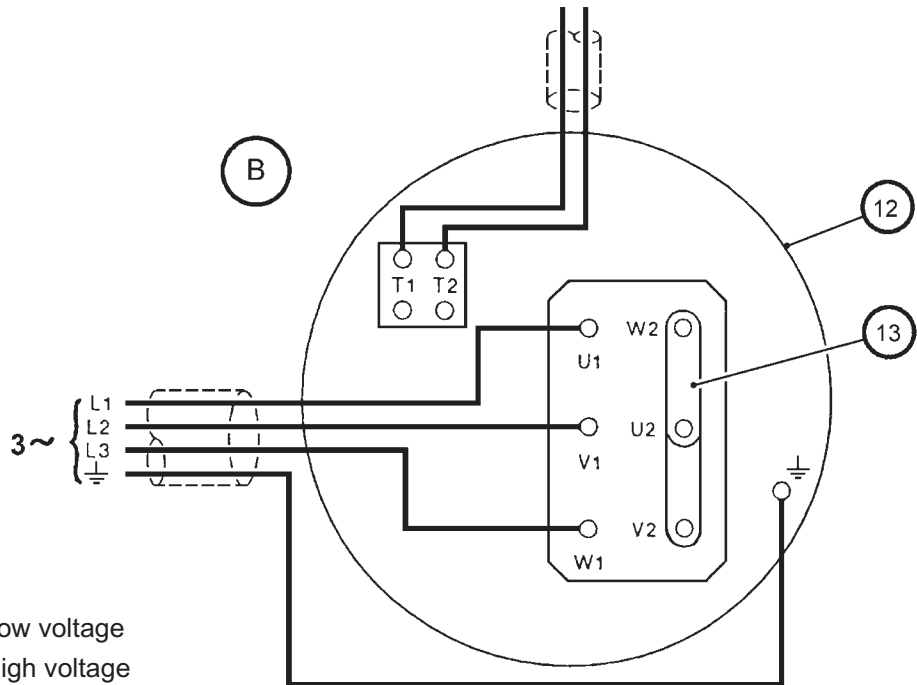


Figure 3-11 - Reconfigure the pump-motor terminal-boxes



dcsl103/001



dcsl103/002

- A Low voltage
- B High voltage

Figure 3-12 - QMB500 low and high-voltage configuration

2. Undo and remove the four screws (3) which secure the cover (2) to the HCDP pump-motor terminal-box.
3. Look at the links (9) in the terminal-box (8):
 - For high voltage operation (380-415 V at 50 Hz or 460 V at 60 Hz), ensure that the links (9) are in the positions shown in detail A.
 - For low voltage operation (200-208 V at 50 Hz or 200-230 V at 60 Hz), ensure that the links (9) are in the positions shown in detail B.
4. Refit the cover (2) to the HCDP pump-motor terminal-box and secure with the four screws (3).
5. Refit the blanking plate (4) and secure with the six screws (5).
6. Undo and remove the four screws (7) which secure the Electrics Box (6) to the rear of the iK system, then carefully lower and support the Electrics Box. Ensure that you do not disconnect, break or damage any of the cables connected to the Electrics Box .
7. Undo and remove the four screws (10) which secure the cover (11) to the QMB pump-motor terminal-box, then remove the cover (through the access hole in the rear cover-plate).
8. Refer to Figure 3-12. Look at the links in the terminal-box (12):
 - For high voltage operation (380-415 V at 50 Hz or 460 V at 60 Hz), ensure that the links (13) are in the positions shown in detail B.
 - For low voltage operation (200-208 V at 50 Hz or 200-230 V at 60 Hz), ensure that the links (13) are in the positions shown in detail A.
9. Refit the cover (11) to the pump-motor terminal-box and secure with the four screws (10).
10. Refit the Electrics Box (6) to the rear of the iK500 system and secure with the four screws (7): ensure that you do not trap any of the cables connected to the Electrics Box .

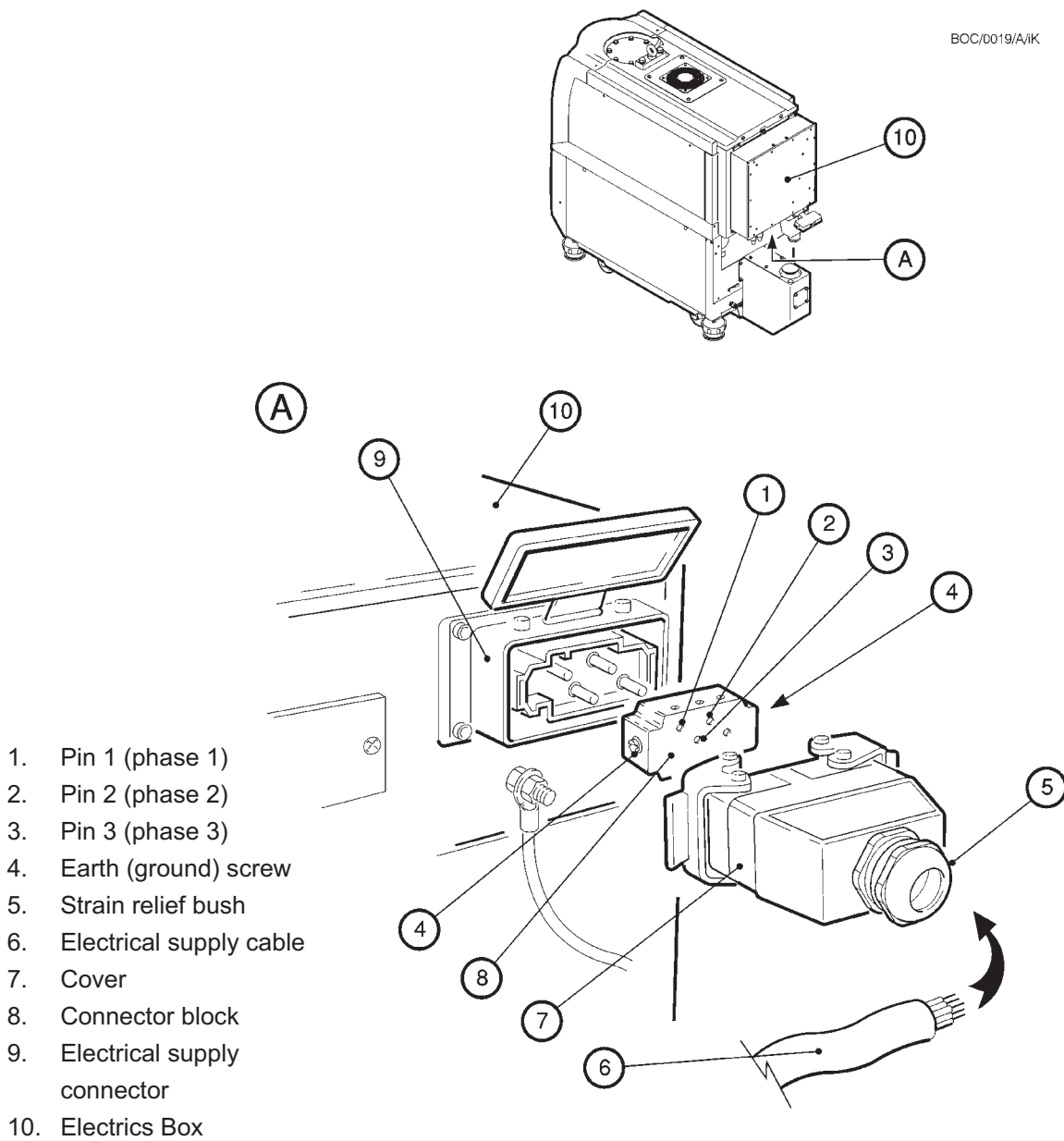



Figure 3-13 - Connect the electrical supply cable to the connector mating-half

3.16.3 Connect the electrical supply to the iK500 system

	<p style="text-align: center;">WARNING</p> <p>This equipment is suitable for Installation Category 2 as defined in IEC 664 (EN61010-1). Connect the iK500 system to the electrical supply through a suitably rated isolator/contactor for your iK500 system (refer to Section 2 and the Notes below).</p>
---	--

	<p style="text-align: center;">WARNING</p> <p>Ensure that the iK500 system and your electrical supply cable are suitably protected against earth (ground) faults and that the earth (ground) conductor of the electrical supply cable is longer than the phase conductors in the connector.</p>
---	--

Use the following procedure to connect the electrical supply to the iK system.

The kit of parts supplied with the pump comprises a connector hood, the connector block, the gland body and five seal inserts of different sizes. The gland body and inserts are supplied together in a single bag. Select the correct size of insert to accommodate the cable, i.e. the size of insert that will only just fit onto to cable. A larger size will not provide an adequate grip of the cable and may allow moisture to penetrate the interior of the connector assembly.

When you make your electrical supply cable, ensure that the earth (ground) conductor is longer than the phase conductors. This will ensure that if the cable is accidentally dragged and the strain relief on the electrical supply connector mating-half gland fails, the earth (ground) conductor will be the last conductor to be pulled from the connector.

1. Refer to Figure 3-13. Remove the connector block (8) from the hood (7) of the mating-half electrical supply connector.
2. Remove the locking nut from the gland and pass the nut over the end of the cable.
3. Select the most suitable size of seal insert and pass that over the end of the cable, with the knurled end towards the cable end.
4. Fit the body of the gland to the hood, ensuring that it is securely fixed, insert the end of the cable through the gland and push the insert fully into the gland body. Then screw the locking nut onto the gland, but do not tighten the nut at this stage.
5. Connect the cable phase wires to the pins of the connector block (8), as shown in Table 3-4.
6. Connect the earth (ground) wire of the cable to one of the two earth (ground) screws (4) on the side of the connector block (8).
7. Refit the connector block (8) into the connector hood assembly (7), and tighten the gland locking nut (5).

8. Fit the mating-half assembly to the electrical supply connector (9) on the Electrics and Pump Control Module (10).
9. Connect the other end of the electrical supply cable to your electrical supply through a suitable isolator.
10. We recommend that you fit a second protective earth (ground) conductor to the protective earth (ground) stud on the Electrics and Pump Control Module (Figure 1-5, item 11) and connect the other end of this conductor to your factory earth (ground).

Wire	Pin number (Figure 3-13 key)
Phase 1 (R)	1
Phase 2 (S)	2
Phase 3 (T)	3

Table 3-4 - Pins in the electrical supply connector

3.16.4 Connect an additional RF earth (optional)

An earth (ground) cable is connected to the rear of the M6 RF earth (ground) stud on the rear panel of the iK500 system (Figure 1-5 item 6). If you will operate the iK500 system in an area subject to high RF (radio frequency) emissions, in accordance with good RF installation practise, we recommend that you:

- Use a star washer to connect the end of the earth (ground) cable connected to the iK500 inlet to one of the bolts that you use to secure the inlet-flange (see Section 3.9).
- Connect an additional earth (ground) cable to the M6 RF earth (ground) stud. You must use a suitable low-impedance cable (for example, use braided cable).

3.17 Refit the enclosure panels

1. Refer to Figure 3-3:
 - Replace the cover plate (8).
2. Refit the HCDP right-hand and left-hand side panels and the QMB right-hand and left-hand side panels; use the following method for each side panel:
 - Hold the panel (3) and fit it to the side of the iK500 system, so that the pins (5) on the frame engage in the slots in the bottom of the panel (3).
 - Lower the panel fully down, then swing the top of the panel into place against the frame.
 - Use a flat-bladed screwdriver to secure the two quarter-swing catches (2).

3.18 Connect the cooling-water hoses



WARNING

Do not leave the cooling-water supply turned on until after you complete the electrical installation of the pump. If you do, condensation may form inside the motor terminal-box and there may be a risk of electric shock.

CAUTION

Drain the cooling-water from the iK500 system, if you will transport or store it in conditions where the cooling-water could freeze. If you do not, cooling-water may freeze in the iK500 system and damage the pump(s) and/or the cooling-water pipelines.

Notes: For optimum water-cooling, ensure that your cooling-water supply and return hoses are free of restrictions which would reduce the cooling-water flow rate. If you need to connect more than one iK500 system to the water supply, you must connect them in parallel and not in series.

For minimum water consumption, regulate the cooling-water flow to the iK500 system.


The positions of the cooling-water connectors are shown in Figure 1-5. Connect the cooling-water supply as follows:


1. Use $\frac{3}{8}$ inch BSP male pipe fittings (which you must supply) to fit the female quick-release connector to the cooling-water supply hose and to fit the male quick-release connector to the cooling-water return hose.
2. Refer to Figure 1-5. Remove the dust-caps from the cooling-water inlet and outlet (2, 3).
3. Connect your water return hose to the cooling-water outlet (2) and connect your water supply hose to the cooling-water inlet (3).
4. Turn on the cooling-water supply.
5. Inspect the water hoses, pipelines and connections and check that there are no leaks.
6. Turn off the water supply while you complete the remainder of the installation procedures.

3.19 Adjust the interstage purge flow rates if necessary

The $\frac{2}{3}$ -interstage purge and $\frac{3}{4}$ -interstage purge flow rates are preset for correct operation. If necessary, these purge flow rates can be adjusted: contact your supplier or BOC Edwards for advice.

3.20 Commission the iK500 system

	<p style="text-align: center;">WARNING</p> <p>Do not operate the iK500 system with the exhaust pipeline blocked. If the exhaust pipeline is blocked, the iK500 system can generate exhaust pipeline pressures up to 7 bar (7×10^5 Pa).</p>
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	<p style="text-align: center;">WARNING</p> <p>Do not operate the iK500 system with any enclosure panels removed and do not touch any parts of the pump(s) when the iK500 system is on. Surfaces of the pump(s) are very hot and can cause injury to people.</p>
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3.20.1 Switch on an iK500 system

Note: Operation of the iK500 system with high inlet pressure may result in shaft-seal pressure warnings (refer to Table 6-2): the operation of the iK500 system will not be affected, and you can ignore these warnings.

1. Switch on the external electrical supply and check that the power ok LED (Figure 1-7, item 7) goes on. If the LED does not go on, refer to Section 6 to determine the cause of the fault.
2. Switch on the cooling-water and nitrogen supplies.
3. Ensure that the exhaust-extraction system is not blocked (for example, that valves in the exhaust-extraction system are open).
4. Ensure that all openings to atmospheric pressure in the foreline vacuum system are closed, then switch on the iK500 system.
5. If the iK500 system starts and continues to operate, continue at Step 6. If a warning or alarm condition is indicated (for example, a warning or alarm message is shown on the Pump Display Terminal):
 - Shut down the iK500 system: refer to Section 5.10.
 - Refer to Section 6 to determine the cause of the fault and to rectify the fault.
6. Look at the pressure guage in your inlet pipeline:
 - If the pressure is increasing, the HCDP Pump motor terminal box and/or the QMB pump motor terminal box is incorrectly wired. Immediately shut down the system, correct the wiring (refer to Section 3.16.2) and repeat procedure.
 - If the pressure is decreasing, continue to step 7.
7. Watch the motor-coupling in the sight-glass (Figure 3-5, item 7).

8. Check that the direction of rotation of the coupling is the same as that indicated by the rotation arrow on the motor and shown in Figure 3-5.
9. If the direction of rotation of the coupling is incorrect, switch off the backing-pump and isolate the QMB pump from the electrical supply. Reverse any two of the phase-wires in the motor terminal-box.
10. Repeat the check to ensure that the direction of rotation is now correct.
11. After you have commissioned the iK500 system:
 - If you want to continue to operate the iK500 system, refer to Section 5.
 - Otherwise, shut down the system,; refer to Section 5.10.

3.21 Install the disconnect box (accessory)

The following sections provide the installation of the disconnect box to your system. The disconnect box general arrangement is shown in Figure 1-9.

3.21.1 Unpack and inspect

Remove all packing materials and protective covers and check the controller. If the controller is damaged, notify the supplier and carrier in writing within three days; state the item number of the controller together with the order number and supplier's invoice number. Retain all packing materials for inspection. Do not use the controller if damaged. Check that the package contains the following items:

Qty	Description	Check (✓)
1	Disconnect Box	<input type="checkbox"/>
2	EMO Shroud	<input type="checkbox"/>
3	Pump Power Cable	<input type="checkbox"/>

Table 3-5 Inspection Check List

3.21.2 Mounting

The disconnect box is a wall mount unit which utilises the four mounting holes on the back wall of the box. Height requirements for the mounting box are shown in Figure 3-14.

Note: The disconnect box must be mounted in close proximity to the iK500 system.

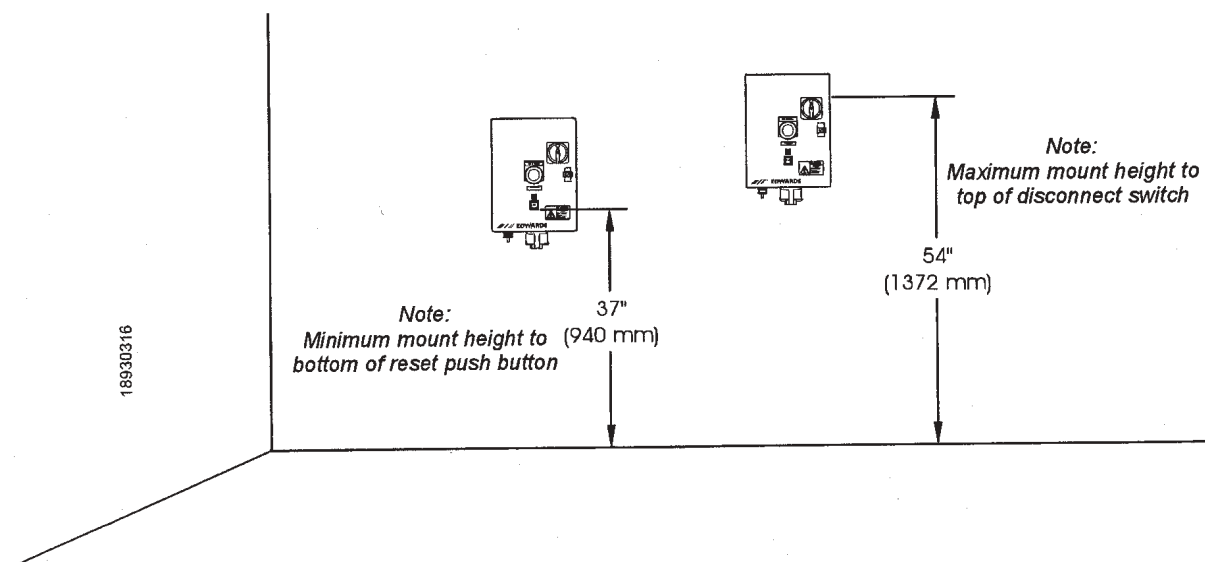


Figure 3-14 Disconnect box mounting height requirements

3.21.3 Electrical Installation

The electrical schematic is shown in Figure 3-15. The electrical connections between the disconnect box, incoming electrical supply and pump are described in the following sections. Refer to Figure 3-16 for electrical supply connections, and Figure 3-17 for cable connections.

All hardware required to install the disconnect box is provided in the loose parts package.

3.21.4 Main Electrical Supply

Connect the power supply to the disconnect box using the following steps:

1. Punch out the power supply inlet hole plug on the top of the disconnect box.
2. Tie in the customer power to the supply side of the fused mains disconnect as shown in Figure 3-16.
3. Tie in dedicated grounding and neutral conductors to an open position on the grounding bar and neutral terminal, respectively.
4. If the photohelic gauge is installed, ensure that circuit breaker CB1 is reset, then close the disconnect box door.
5. Using a flat screwdriver, secure the door by turning the lock.

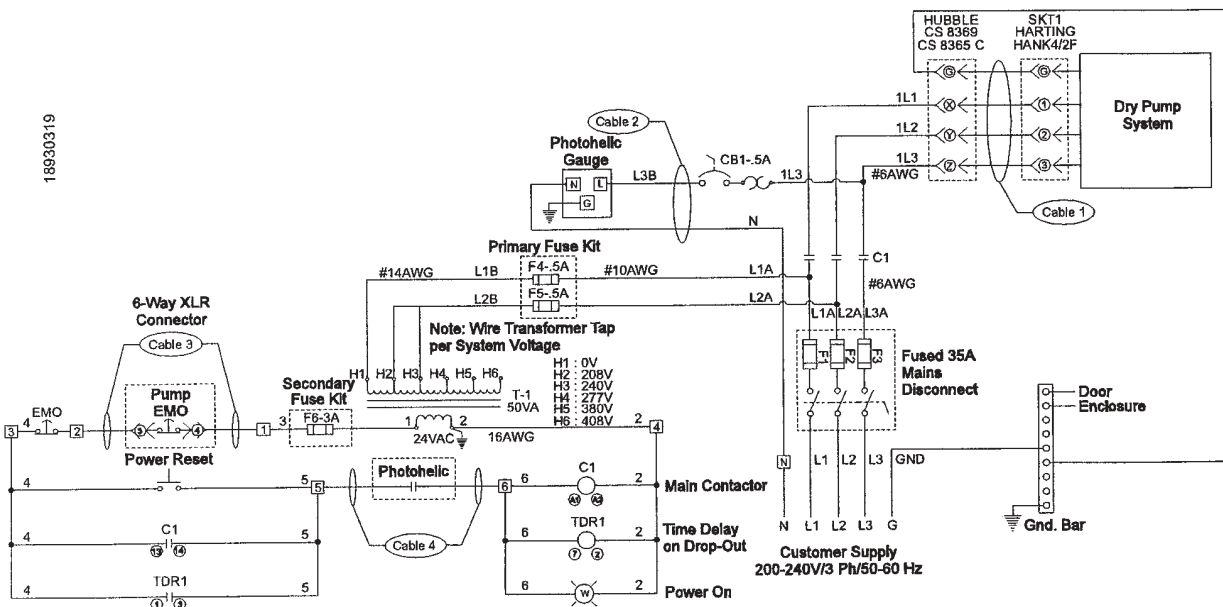


Figure 3-15 Disconnect box electrical schematic

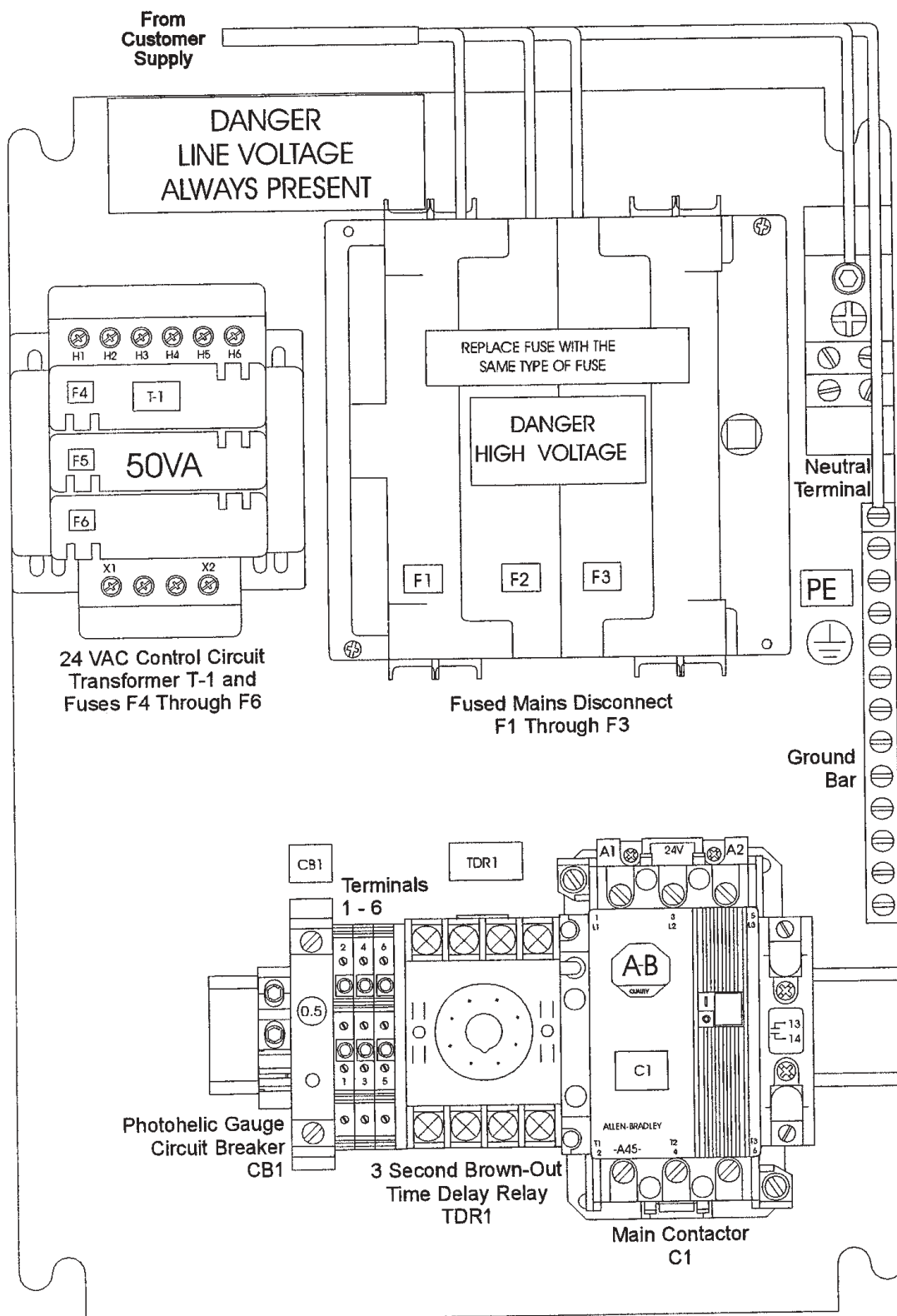


Figure 3-16 Disconnect box sub-panel general arrangement

3.21.5 Cable Connections

Connect the cables from the disconnect box to the appropriate locations as follows:

1. Punch out the EMO cable outlet hole (2) on the bottom of the disconnect box. (See Fig 3-17)
2. Connect the cable cores to terminals 1 and 2 of the disconnect box. (See Fig 3-15 and 3-16)
3. Plug the 6-wayXLR connector into the Tool Interface Module of the iK500 system. (See Fig 1-5).

See Section 3.22 for photohelic switch/gauge connections.

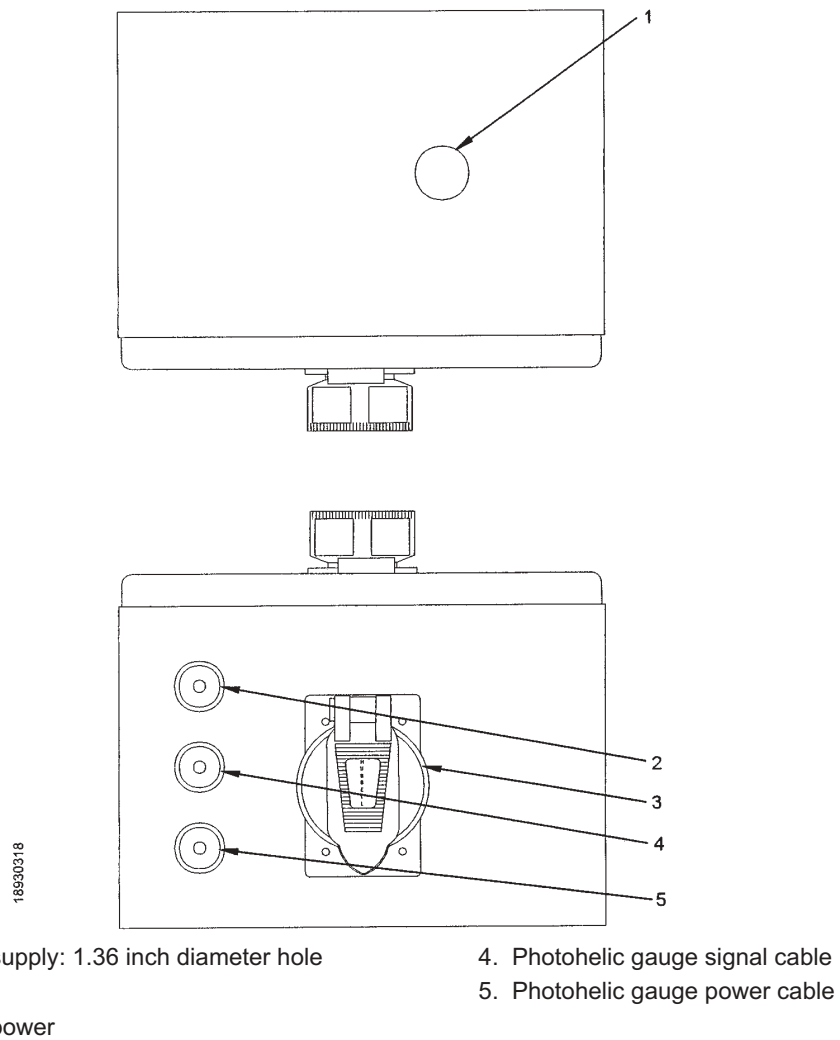


Figure 3-17 Disconnect box cable connections

3.22 Install photohelic switch/gauge (accessory)

The following sections provide the installation of the photohelic switch/gauge to your system. Note that installation of the photohelic gauge is only possible if the disconnect box has been installed.

3.22.1 Unpack and inspect

Remove all packing materials and protective covers and check the switch/gauge. If the switch/gauge is damaged, notify the supplier and carrier in writing within three days; state the item number of the switch/gauge together with the order number and supplier's invoice number. Retain all packing materials for inspection. Do not use the switch/gauge if damaged. Check that the package contains the following items:

Qty	Description	Check (✓)
1	Photohelic Switch/Gauge complete with Power Signal Cables	<input type="checkbox"/>
2	Photohelic Mounting Bracket	<input type="checkbox"/>
3	Braided ¼" Hose complete with Tube Fittings	<input type="checkbox"/>

Table 3-6 Inspection Check List

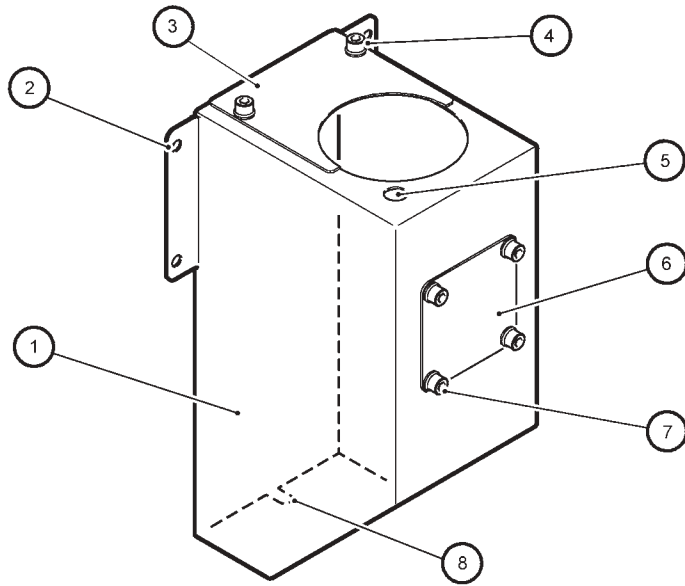
3.22.2 Mounting

The photohelic switch/gauge is a wall mount unit. The mounting instructions are described in the accessories manual.

3.22.3 Piping Connections

Connect the piping between the photohelic switch/gauge and the iK500 exhaust enclosure using the following steps:

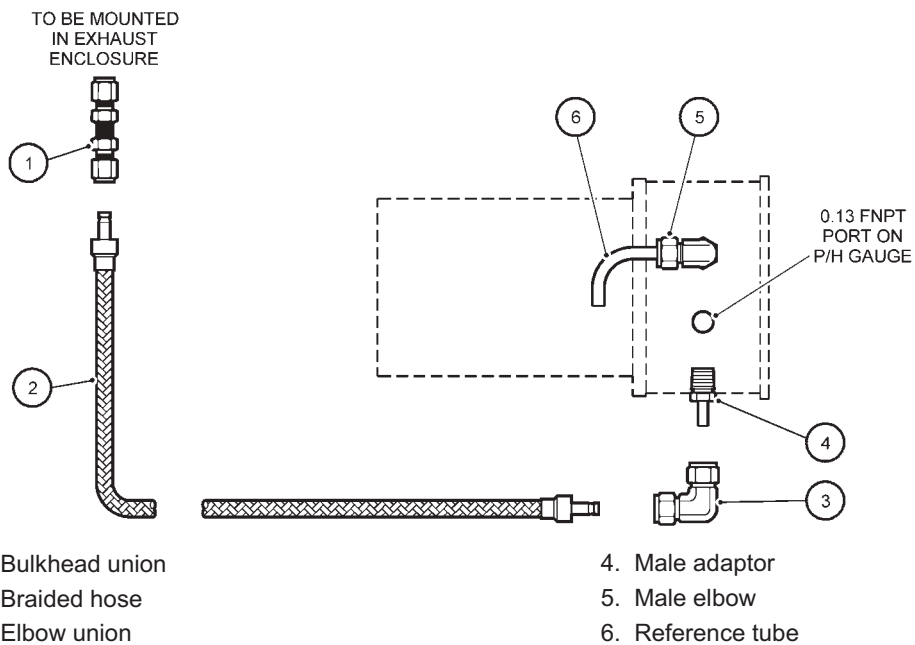
1. See Figure 1-1. Remove the exhaust enclosure (23) by removing the screws connecting to the rear bulkhead cover, drip tray (24) and exhaust enclosure top plate. (See also Figure 3-18).
2. See Figure 3-18. Remove rubber plug (5) from the exhaust enclosure (1).
3. See Figure 3-19. Connect the bulkhead union (1) to the hole on top of the exhaust enclosure. (See Section 6.2 for guidelines)
4. See Figure 1-1. Refit the exhaust enclosure (23) using the screws connecting to the rear bulkhead cover, drip tray (24) and exhaust enclosure top plate. (See also Figure 3-18).
5. See Figure 3-19. Connect the braided hose to the bulkhead union (1) on the exhaust enclosure and to the photohelic gauge port as shown. (See Section 6.2 for guidelines).



dcs/103/003

- | | |
|--------------------------------------|------------------------------------|
| 1. Exhaust enclosure | 5. Rubber plug |
| 2. Screws to rear bulkhead cover (4) | 6. Air-extraction port cover |
| 3. Top plate | 7. Air-extraction cover screws (4) |
| 4. Top plate screws (2) | 8. Screw to drip tray |

Figure 3-18 Exhaust enclosure details



dcs/0103/004

- | | |
|-------------------|-------------------|
| 1. Bulkhead union | 4. Male adaptor |
| 2. Braided hose | 5. Male elbow |
| 3. Elbow union | 6. Reference tube |

Figure 3-19 Photohelic gauge piping connections

3.22.4 Cable Connections

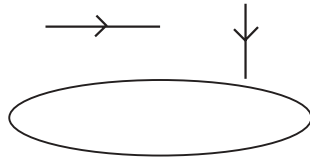
Connect the cabling between the photohelic switch/gauge and the disconnect box as follows:

1. Using a flat screwdriver, open the disconnect door by turning the lock.
2. Ensure power to the disconnect box is isolated and that CB1 is open.
3. Punch out the photohelic gauge signal and power cable holes on the bottom of the disconnect box. (Items 4 and 5 on Fig 3-17)
4. Connect the photohelic switch/gauge signal cable to terminals 5 and 6 (See Fig 3-15 and 3-16).
5. Connect the photohelic switch/gauge power cable to CB1, the Neutral Terminal and the Ground Bar. (See Fig 3-15 and 3-16)
6. Restore power to the disconnect box and Close CB1
7. Using a flat screwdriver, secure the disconnect door by turning the lock.

4 PUMP DISPLAY TERMINAL MENUS AND DISPLAY FORMATS

4.1 Introduction

The menus used and the display messages shown on the Pump Display Terminal are described in the menu diagrams in Figures 4-2 to 4-19. The following symbols and conventions are used in the menu diagrams:



These are flow lines. Arrows on the lines show the direction of flow through a menu.

This symbol is used to connect different menus and shows the starting point (or continuation point) of a menu. The symbol is shown with the menu name and, where applicable, a reference of the form [4-x/y]. This reference specifies that the menu continues on (or is continued from) a menu shown on sheet y of Figure 4-x. The sheet reference (/y) is omitted where it is not necessary.



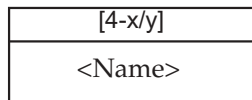
This symbol is used for the ENTER and CANCEL buttons and the four menu buttons: Normal, Status, Control and Setup.



This symbol is used for the up (▲) and down (▼) buttons and for the on (◊) and off (⊖) buttons.



This symbol is used for the two-line display on the Pump Display Terminal. With the exception of variable text (see Section 4.4), the text shown in the symbol is the text that will be shown on the display.



This symbol is a subroutine box and is used to represent a 'subroutine call'; a subroutine is a series of menu steps which are used in a number of different menus or used in different parts of one menu. The [4-x/y] reference (used as described above) shows where the subroutine is expanded.

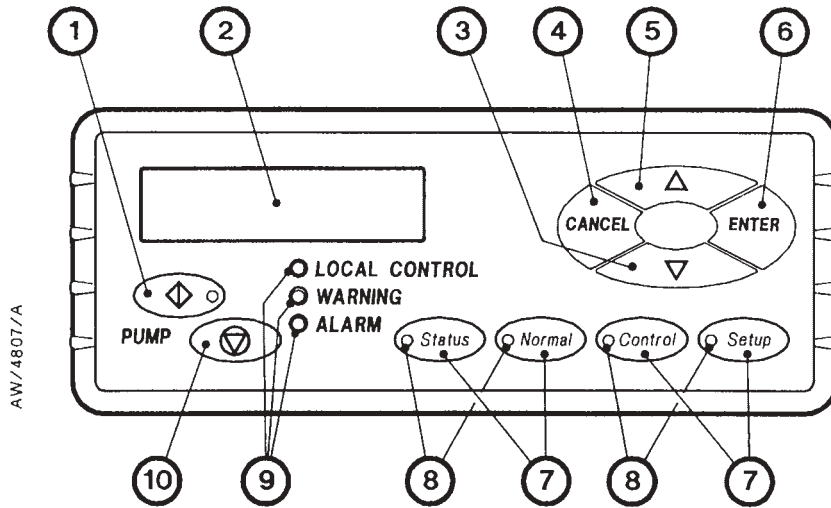
In a menu which 'calls' a subroutine, where a menu flow line meets the left hand side of a subroutine box, this means that flow continues at the start connector (identified by <name>) of the subroutine. At the 'exit' connector of the subroutine, flow continues in the (calling) menu along the flow line to the right of the subroutine box.



This symbol shows additional text which is not part of the menu, but which further describes the operation of the menu.

4.2 General operation

When you first switch on the iK500 system, the normal display is shown: see Figure 4-5. Refer to Figure 4-1. You can then press the On or Off button (1 or 10) or any of the four menu buttons (7) to enter the corresponding menu. Then, regardless of the current menu and display status, when you press any of these buttons, you exit the current menu and enter the corresponding new menu. Figure 4-2 shows this menu control logic.



- | | |
|------------------|-----------------------|
| 1. On button | 6. ENTER button |
| 2. Display | 7. Menu buttons |
| 3. Down button | 8. Menu selected LEDs |
| 4. CANCEL button | 9. Status LEDs |
| 5. Up button | 10. Off button |

Figure 4-1 - Front panel of the Pump Display Terminal

4.3 The CANCEL button

You can press the CANCEL button at any time during menu operation. For this reason, we have not shown the use of the CANCEL button on all of the menu diagrams, but we have shown specific uses where there is no other obvious way to cancel the current menu option and enter the previous menu option. In general, when you press the CANCEL button, the current menu option is cancelled and the previous menu option is displayed.

Other specific uses of the CANCEL button are as follows:

- In the Switch On and Switch Off menus (Figures 4-3 and 4-4), when you press CANCEL, the menu is exited and the normal display is shown.
- In the Status menu (Figure 4-6), when you press CANCEL the display shows the first two status parameters (the defaults are HCDP current consumption and power consumption).
- When you change passwords in the Setup and Service menus (Figures 4-8 and 4-13) and before you press the ENTER button, if you press CANCEL, the menu moves back to entry of the first digit of the password or serial number.

4.4 Display text and variable text

In the menu diagrams in Figures 4-2 to 4-19, text shown without chevron brackets in the two-line display symbol is the actual text that will be shown on the display. In this text, the 'Δ' symbol is used to show where a digit will be shown; the value of the digit depends on the sensor data or information you enter into the Pump Display Terminal.

Text enclosed in chevron brackets (for example, <status>) defines variable text; what is shown on the display depends on the menu or the status of the iK500 system and data entered by the user. The following variable text markers are used on the menu diagrams:

<status>	This specifies the status of a sensor in the iK500 (a Water Flow-Switch). <status> can be any of the following: <ul style="list-style-type: none">• OK indicates that the status is acceptable.• CHECK or LOW indicates that the reading from the sensor is low.• NP (not present) indicates that the sensor is not fitted.• NR (not reading) indicates that the sensor is disconnected, faulty or not switched on.
<serial no./tag>	This specifies a serial number or the user tag. The user tag is a number which you can use to identify the iK500 system in the installation.
<parameter>	This is a previously selected parameter or menu option.
<message>	This specifies a warning, alarm or advisory message.
<e.no>	This specifies an error number: refer to Section 6.
<units>	This specifies setpoint units, for example kW or slm.
<config>	This specifies the gas system configuration and can be any of the following: "low", "medium", "med+exh", or "high".

4.5 Wrap-around

When you use the up and down buttons to change a digit or character on the display, the digit or character will 'wrap-around' between its minimum and maximum values. For example, when you enter a password digit, if the digit is '0' and you press the down button, the digit will change to '9'; if the digit is '9' and you press the up button, the digit will change to '0'.

4.6 Timeout

As supplied, after you have entered a menu (other than the Normal menu), if you do not press a button for five minutes, the Pump Display Terminal will automatically exit the current menu and enter the Normal menu. This facility (known as timeout) is available so that if the setup or service menu is entered and then the iK500 system is accidentally left unattended for a specified time, the menu is exited to prevent unauthorised use of the menu options.

4.7 Menu structure

The menu structure is shown in Table 4-1. Note that if a particular system component or accessory is not fitted, the corresponding menu option or parameter is not shown or is shown as 'NP' (not present).

4.8 Example

Here is an example of how to interpret the menu diagrams. The following procedure describes how to change the units displayed for pressures (you can select kPa or psi).

1. Press the Setup button to enter the Setup menu (Figure 4-8).
2. Use the up and down buttons to change the first digit of the setup password to the correct value, then press the ENTER button.
3. Use the up and down buttons to change the second digit of the setup password to the correct value, then press the ENTER button.
4. Use the up and down buttons to change the third digit of the setup password to the correct value, then press the ENTER button.
5. If you have entered the correct password, the display will then show 'SETUP MENU' on the top line and 'Inlet Purge' on the bottom line.
6. Press the down button six times or press the up button five times; the display will then show 'SETUP MENU' on the top line and 'Units' on the bottom line.
7. Press the ENTER button; the display will then show 'Units Select' on the top line and 'Pressure' on the bottom line (see Figure 4-11).
8. Press the ENTER button; the display will then show 'Pressure' on the top line and the currently selected pressure units on the bottom line.
9. Press the up or down buttons to change the units displayed to the required units, then press the ENTER button. Pressures will now be displayed in the units you selected.

Menu	Figure
Switch on	4-3
Switch off	4-4
Normal	4-5
Status	4-6
Control	4-7
Setup	4-8
Inlet purge	4-8
Gas Ballast	4-8
Gate Valve 1	4-8
Run Til Crash	4-9
Units	4-10
Normal display	4-11
Service	4-12
Serial Numbers	4-13
Zero sensors	4-14
Gas Valve Contrl	4-15
Manual	4-16
View Status	4-17
Messages	4-18
Warning and alarm messages	4-19

Table 4-1 - Menu structure

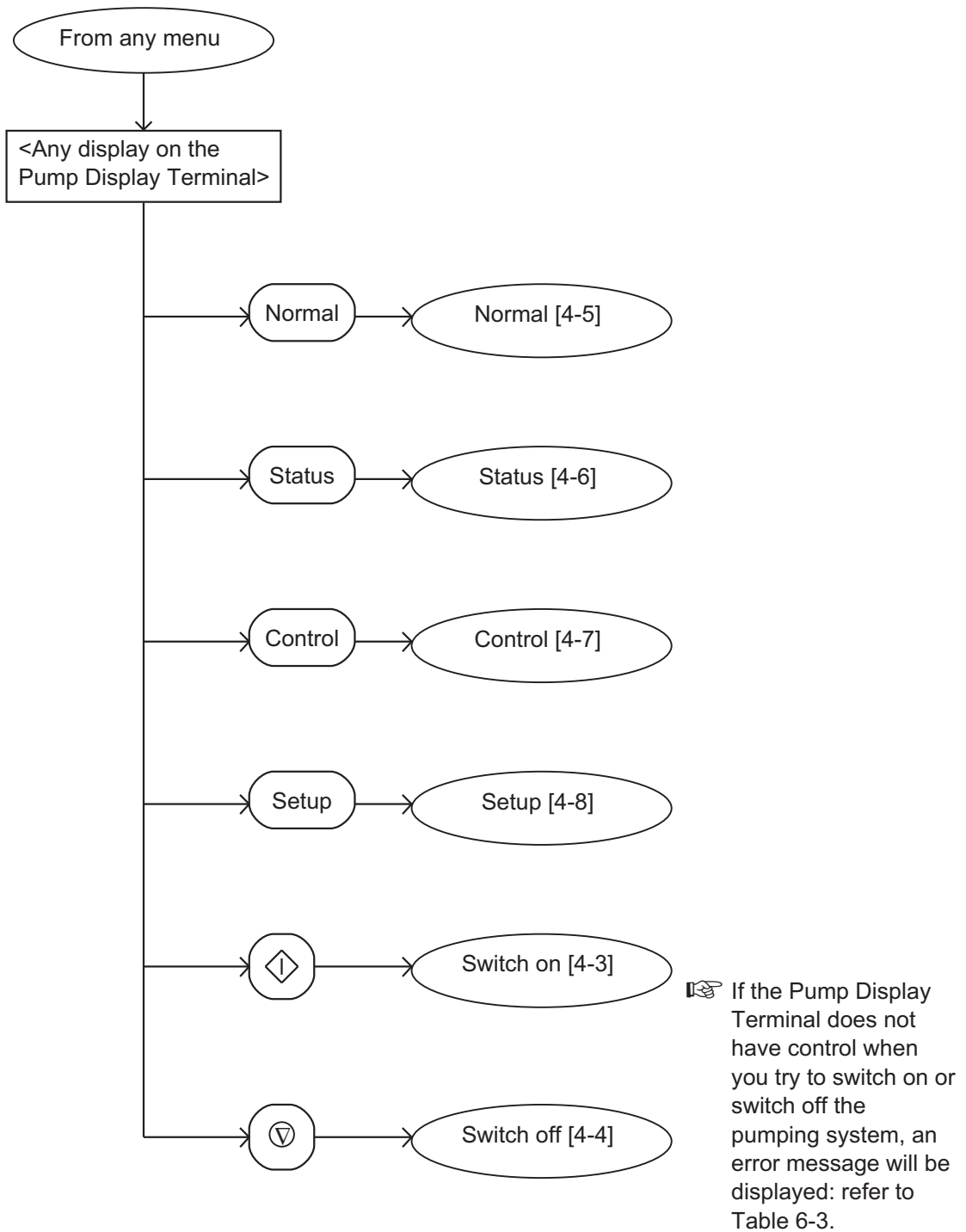


Figure 4-2 - Menu logic

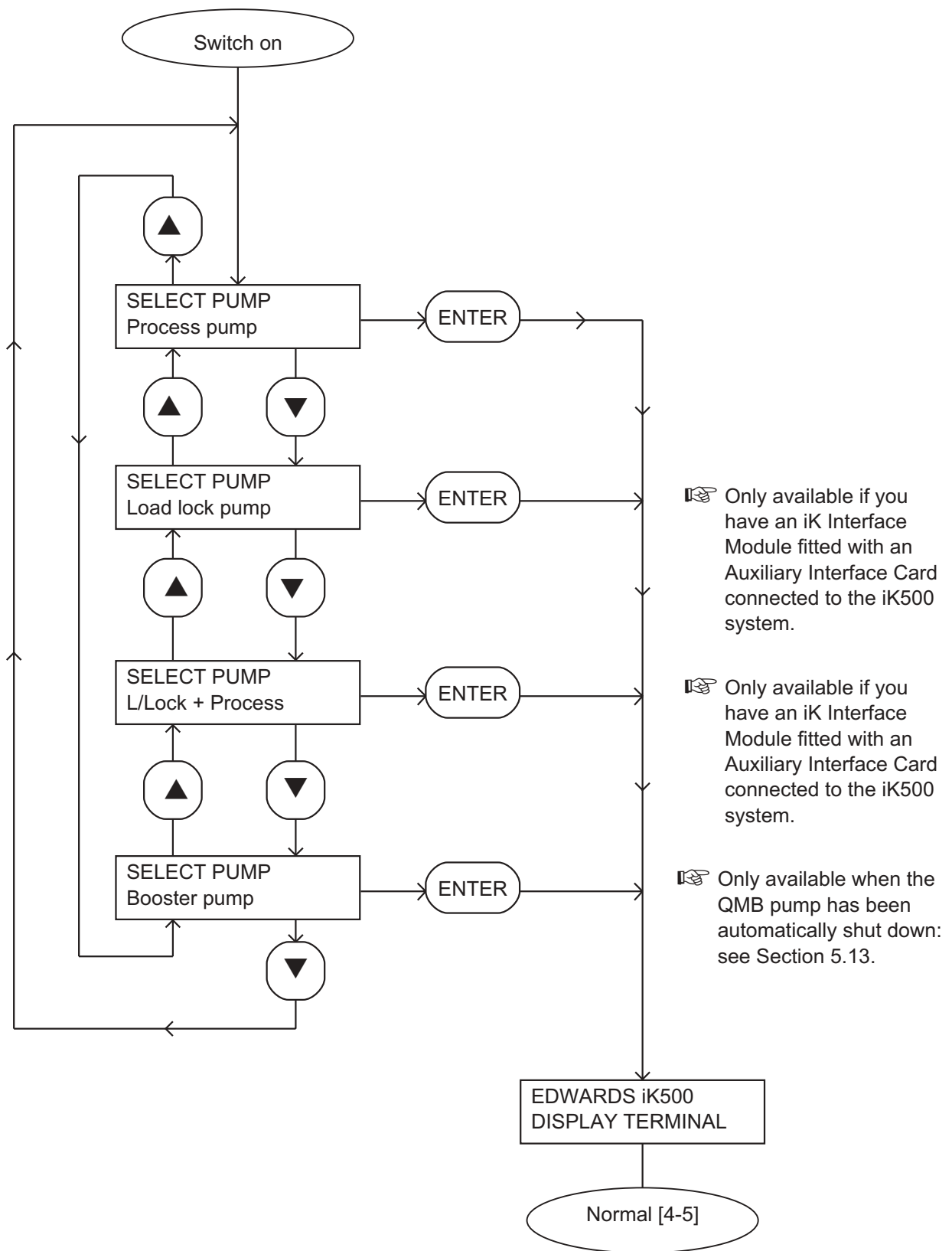


Figure 4-3 - Switch on menu

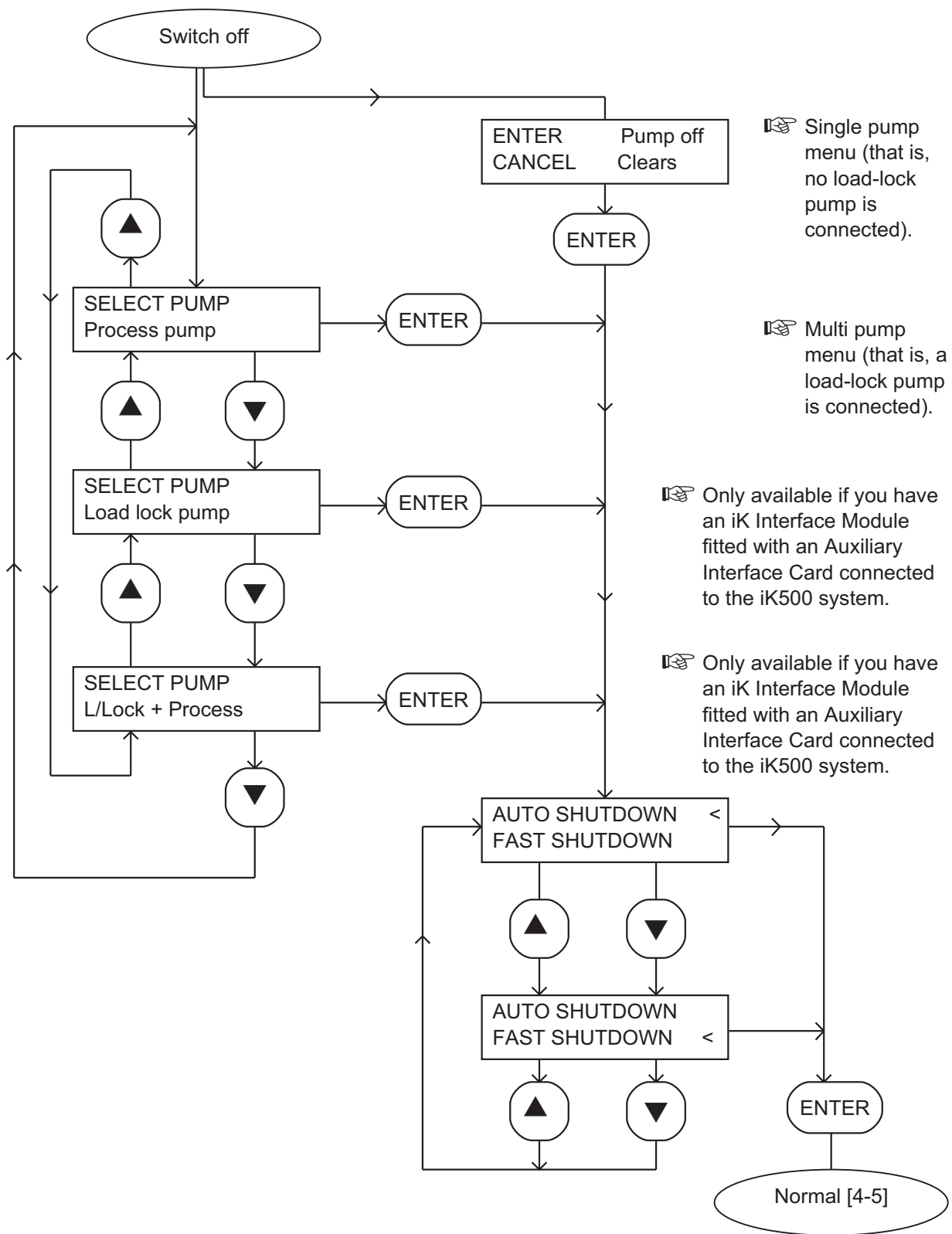
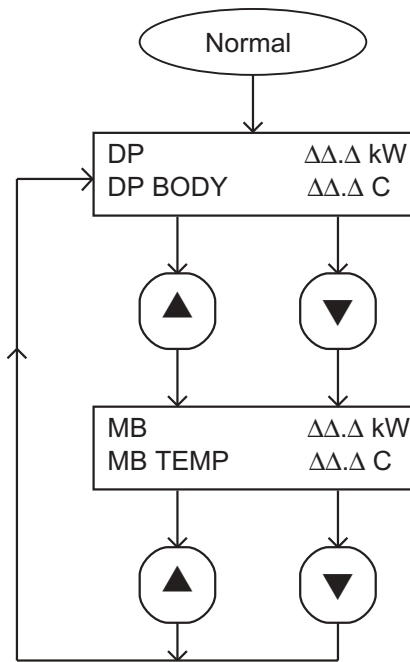


Figure 4-4 - Switch off menu



☞ First page of the normal display

☞ Second page of the normal display

☞ To change the information shown on the two pages, refer to Section 5.

Figure 4-5 - Normal menu

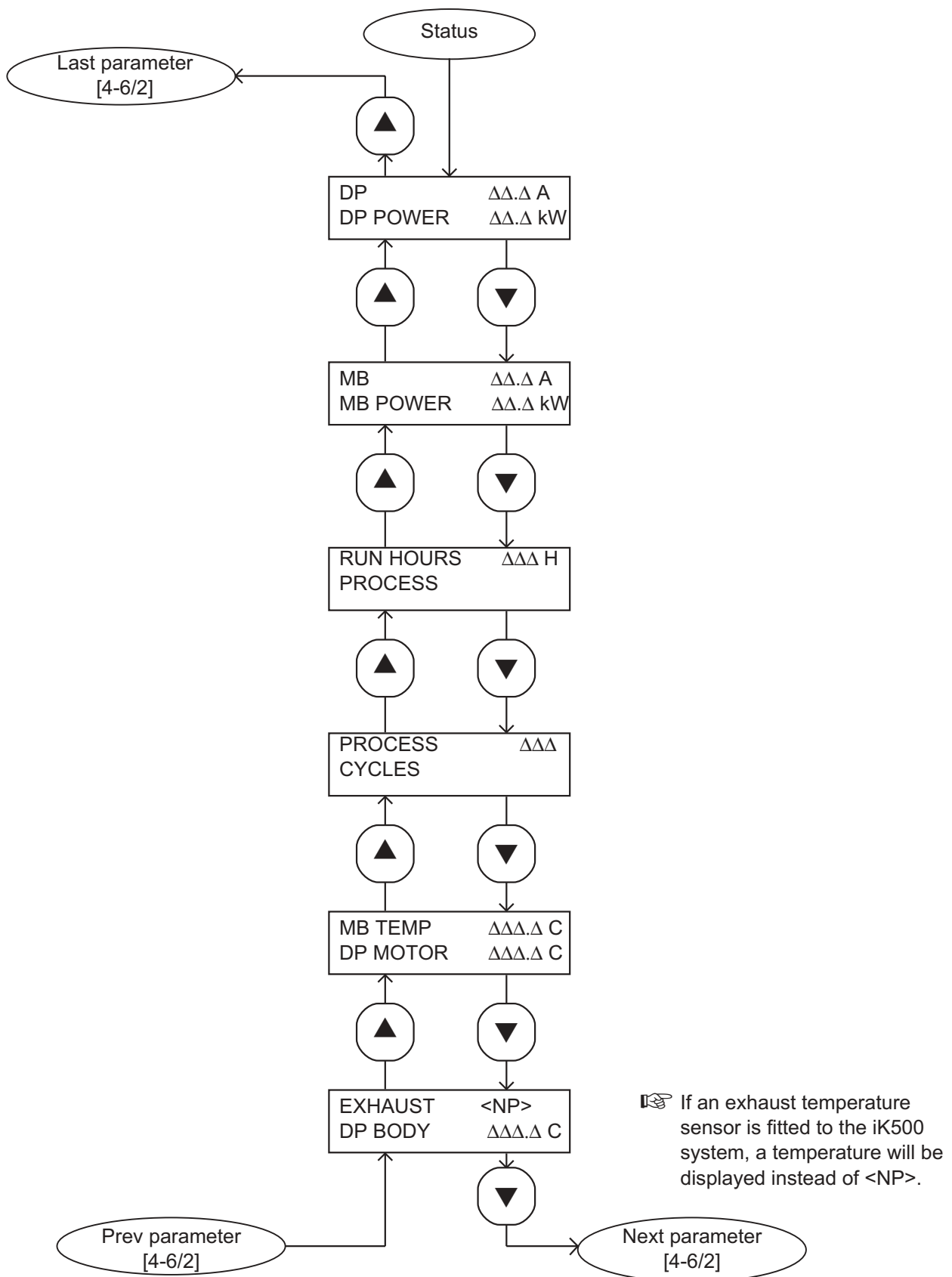


Figure 4-6 - Status menu: sheet 1 of 2

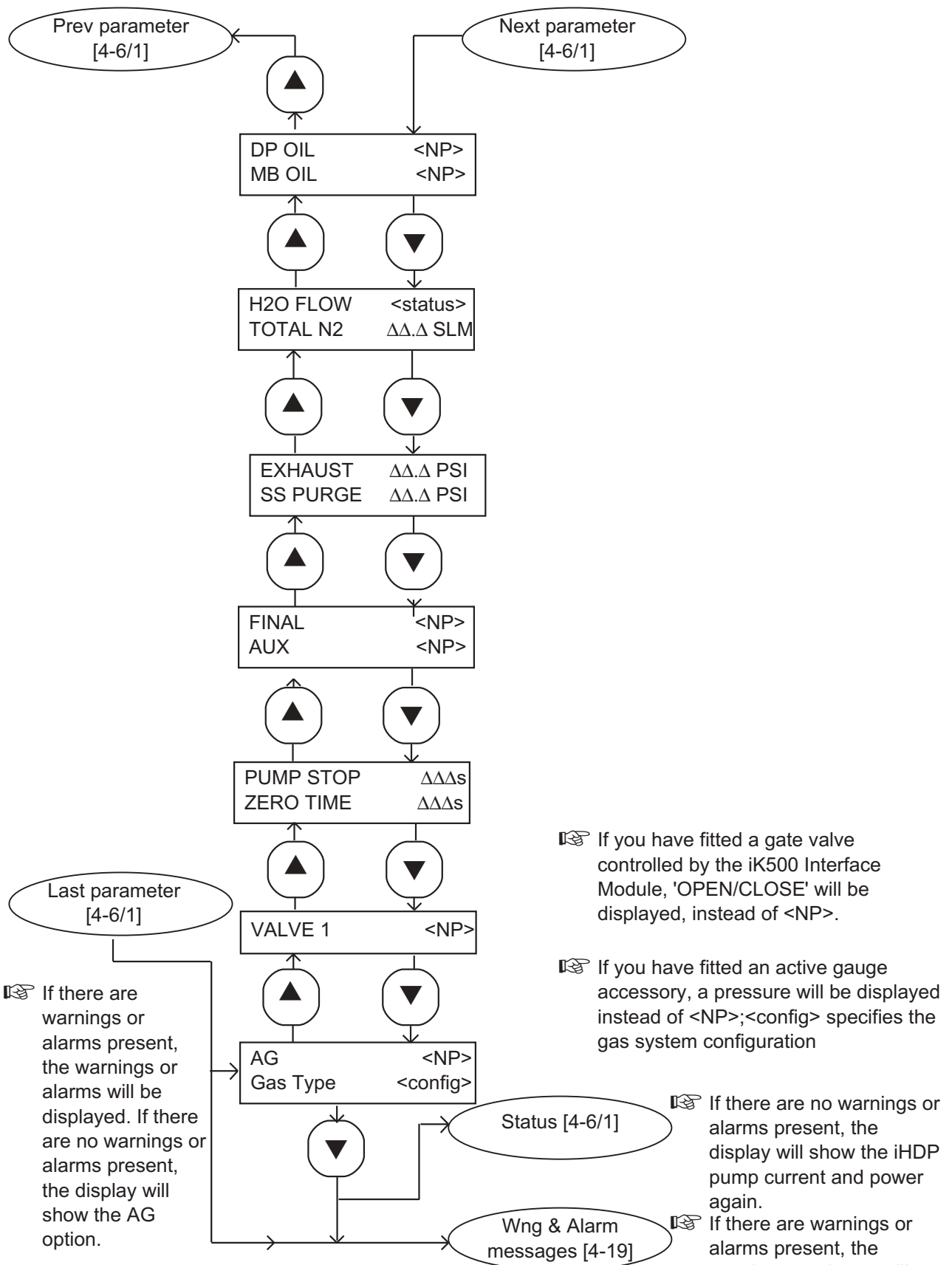


Figure 4-6 - Status menu: sheet 2 of 2

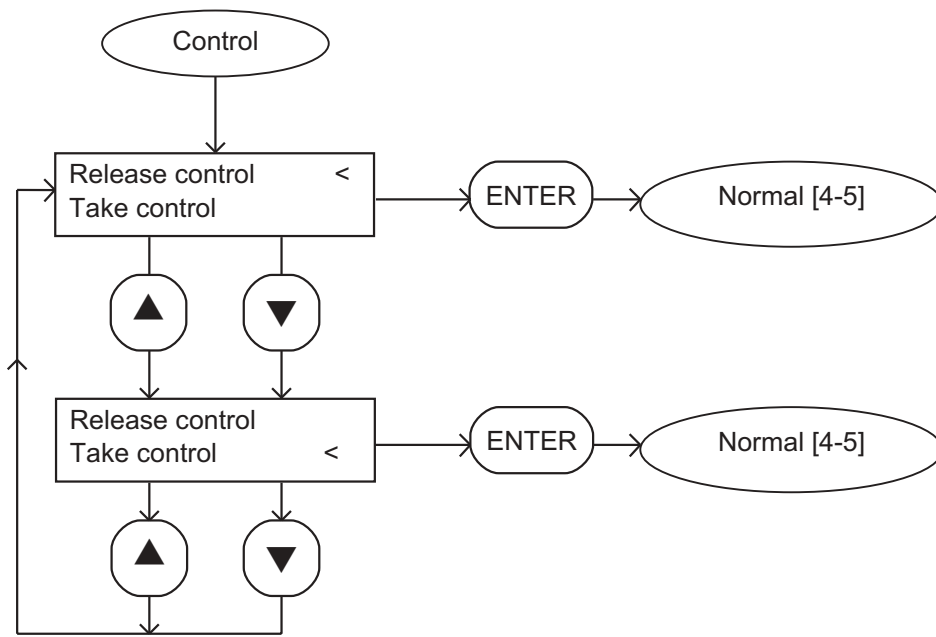


Figure 4-7 - Control menu

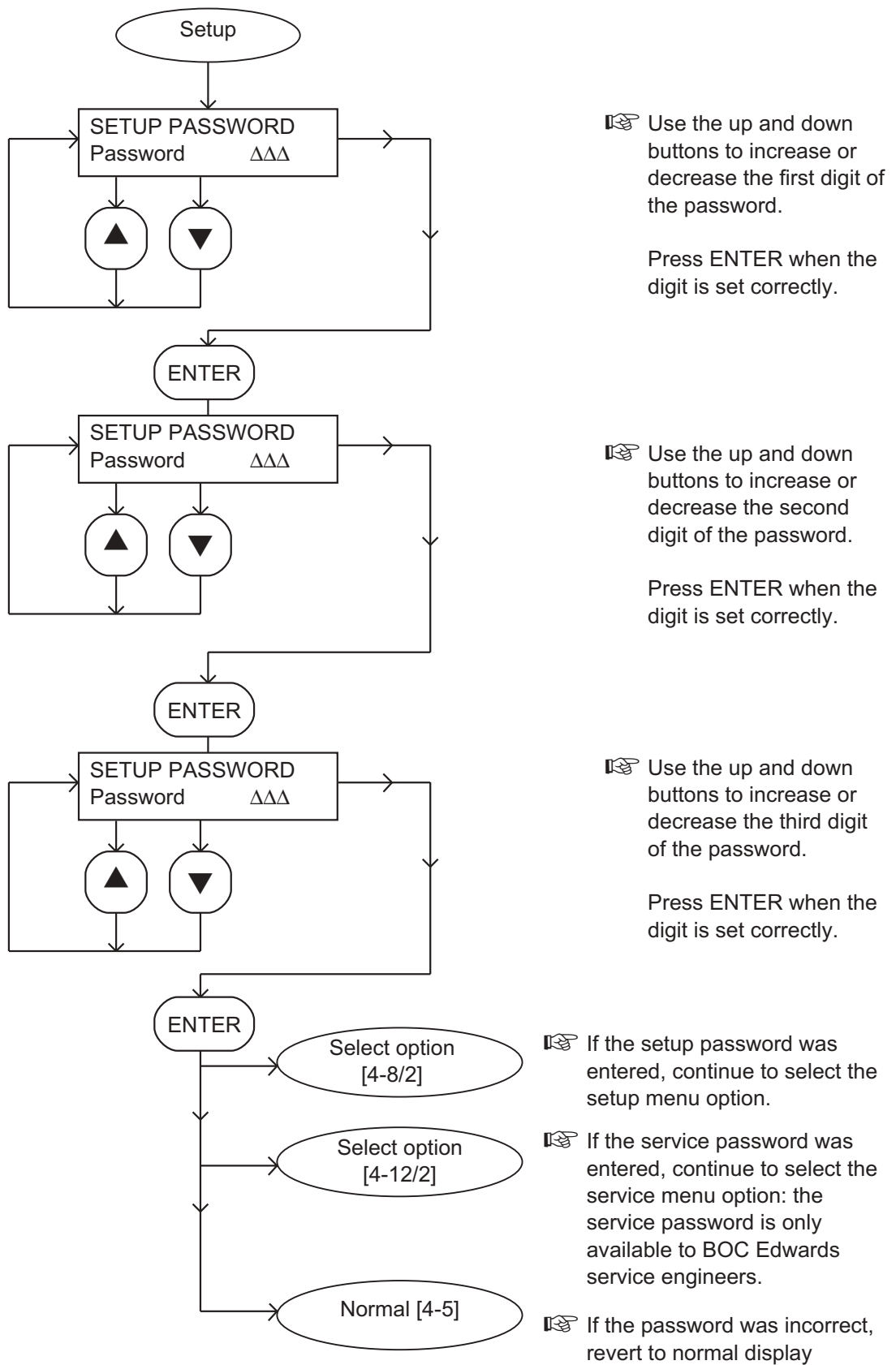


Figure 4-8 - Setup menu: sheet 1 of 3

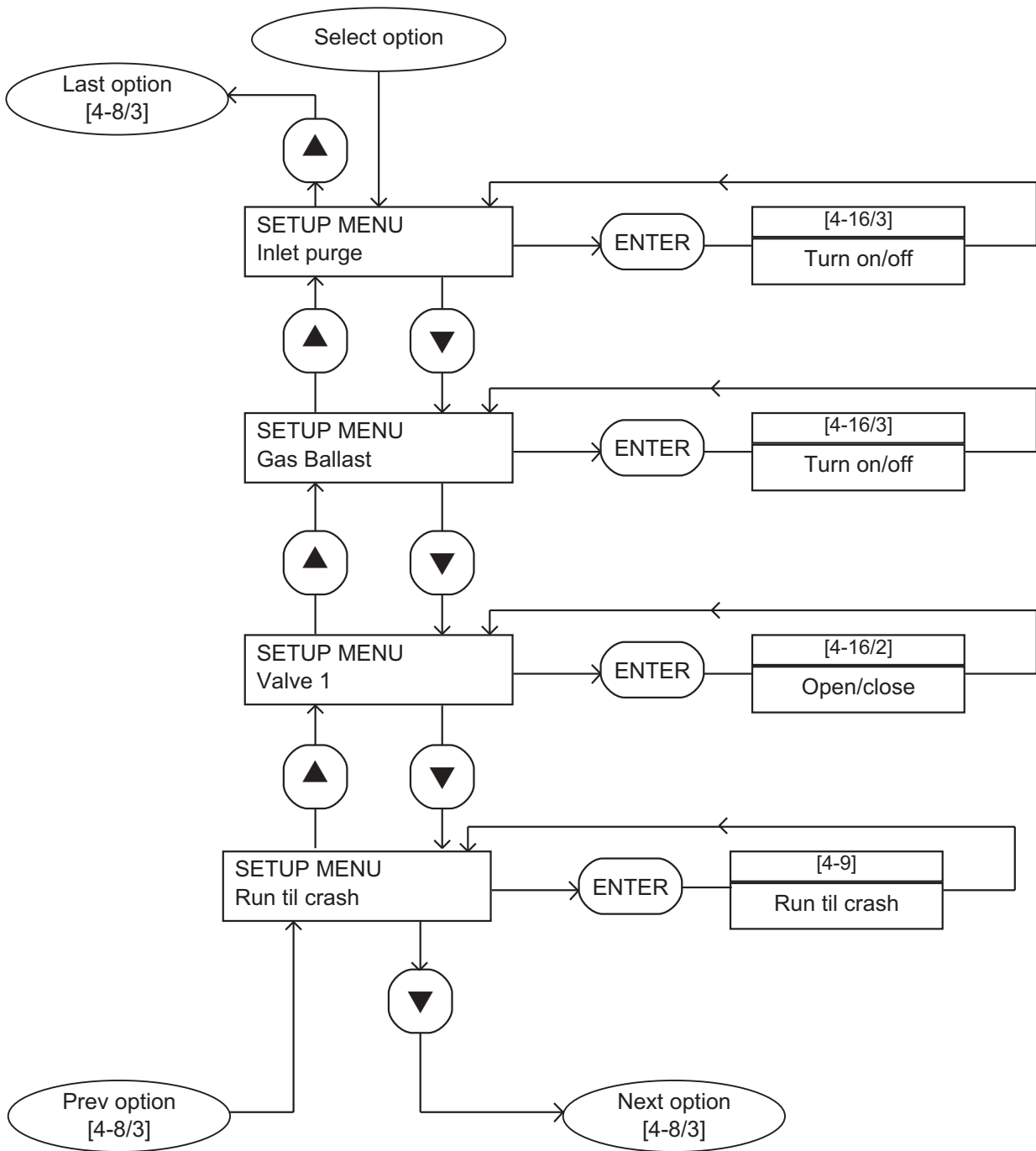


Figure 4-8 - Setup menu: sheet 2 of 3

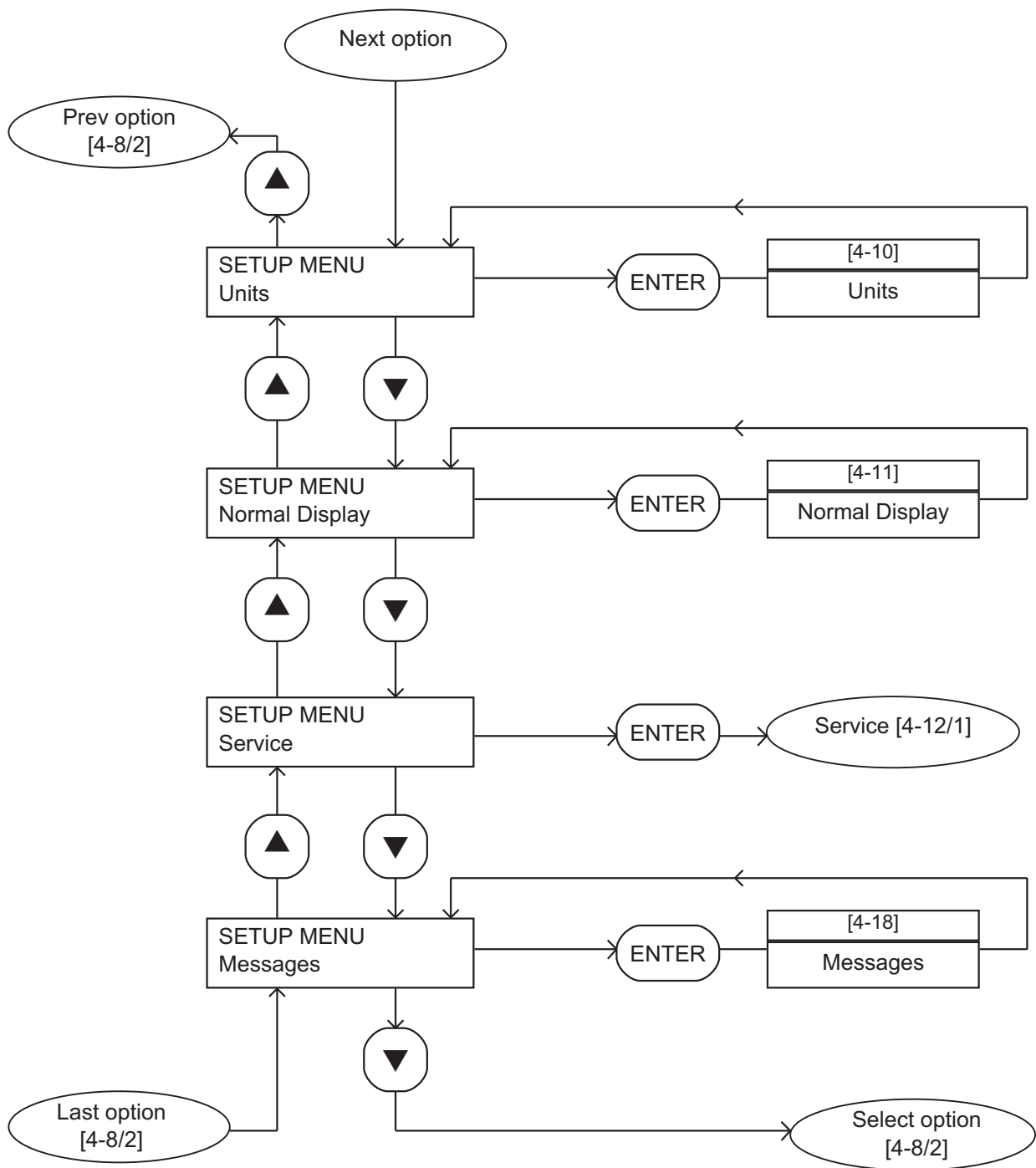


Figure 4-8 - Setup menu: sheet 3 of 3

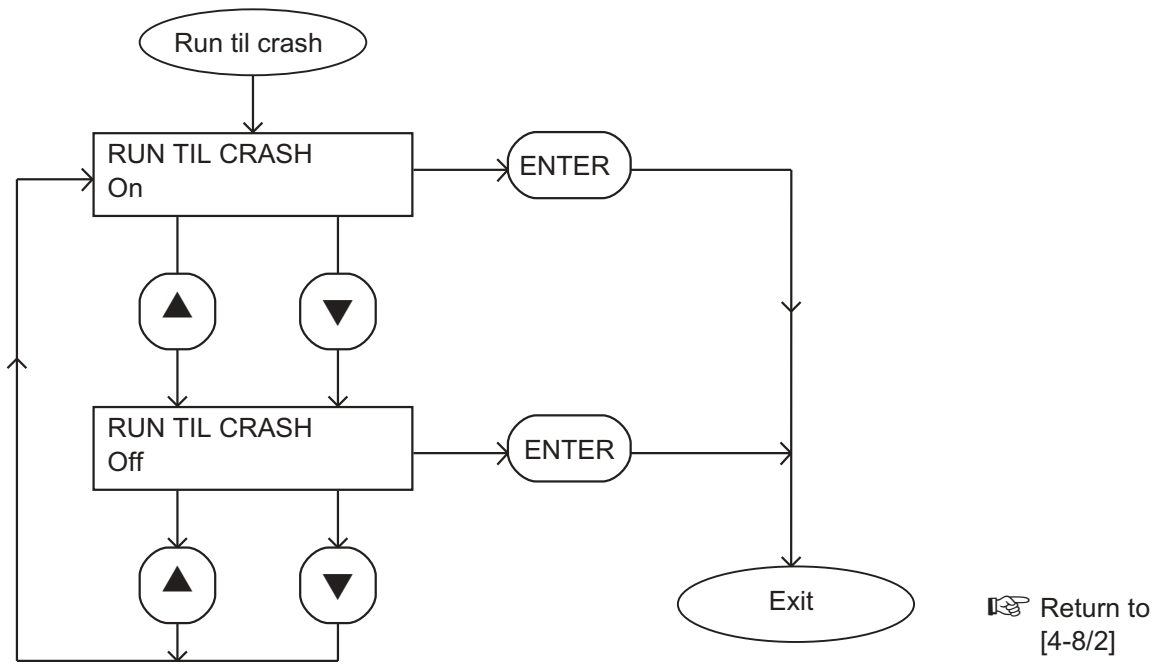


Figure 4-9 - Run til crash menu

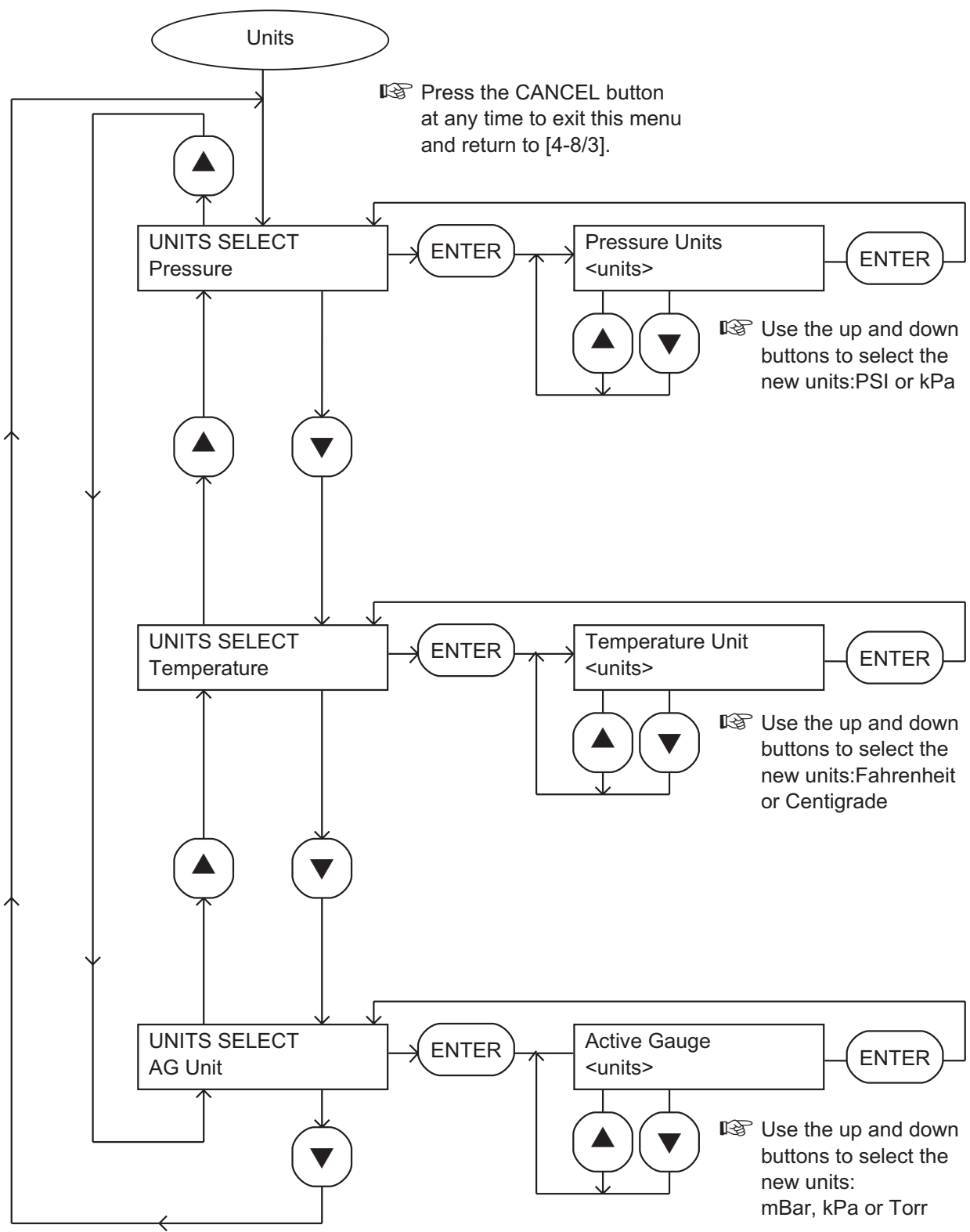


Figure 4-10 - Units menu

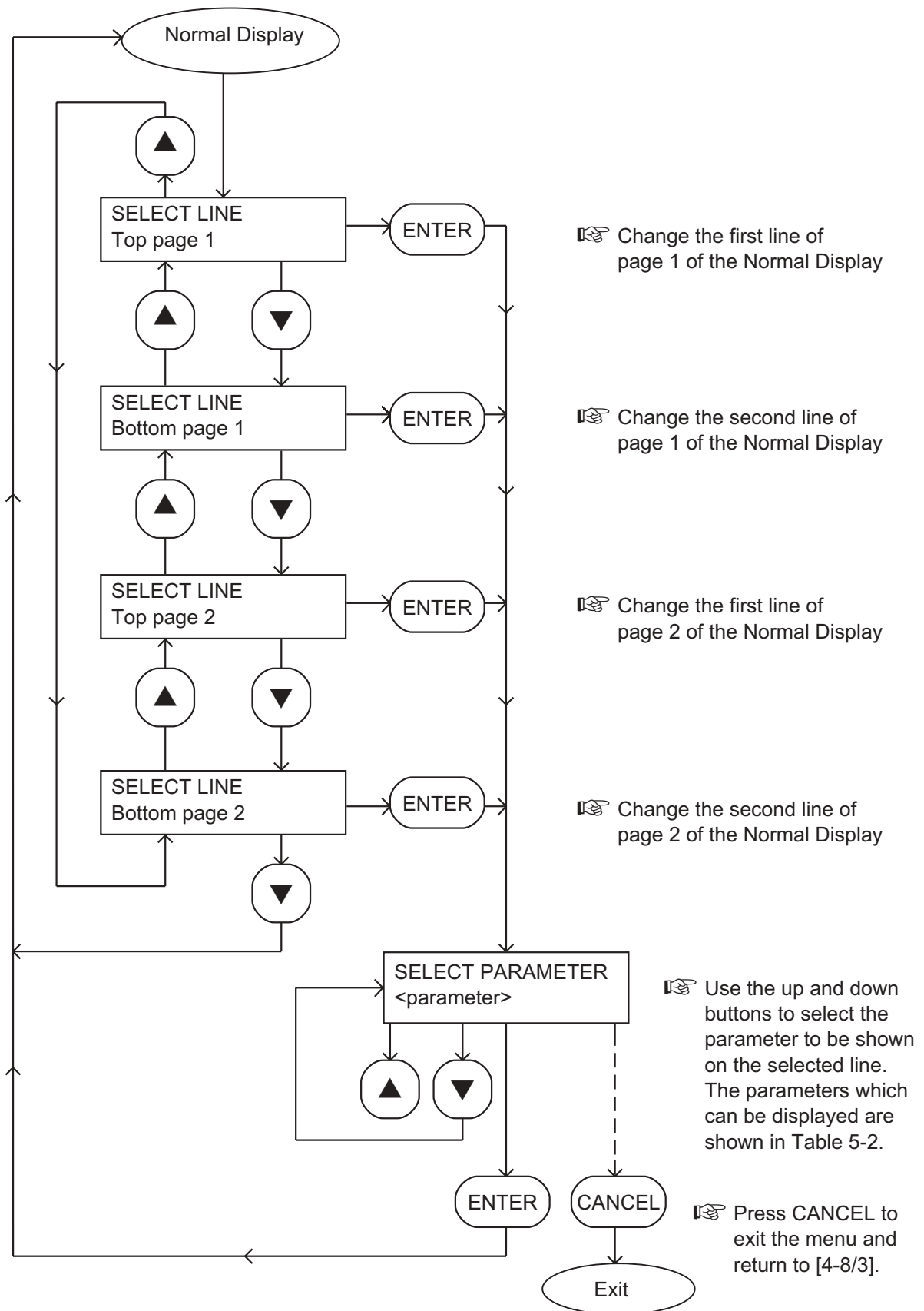
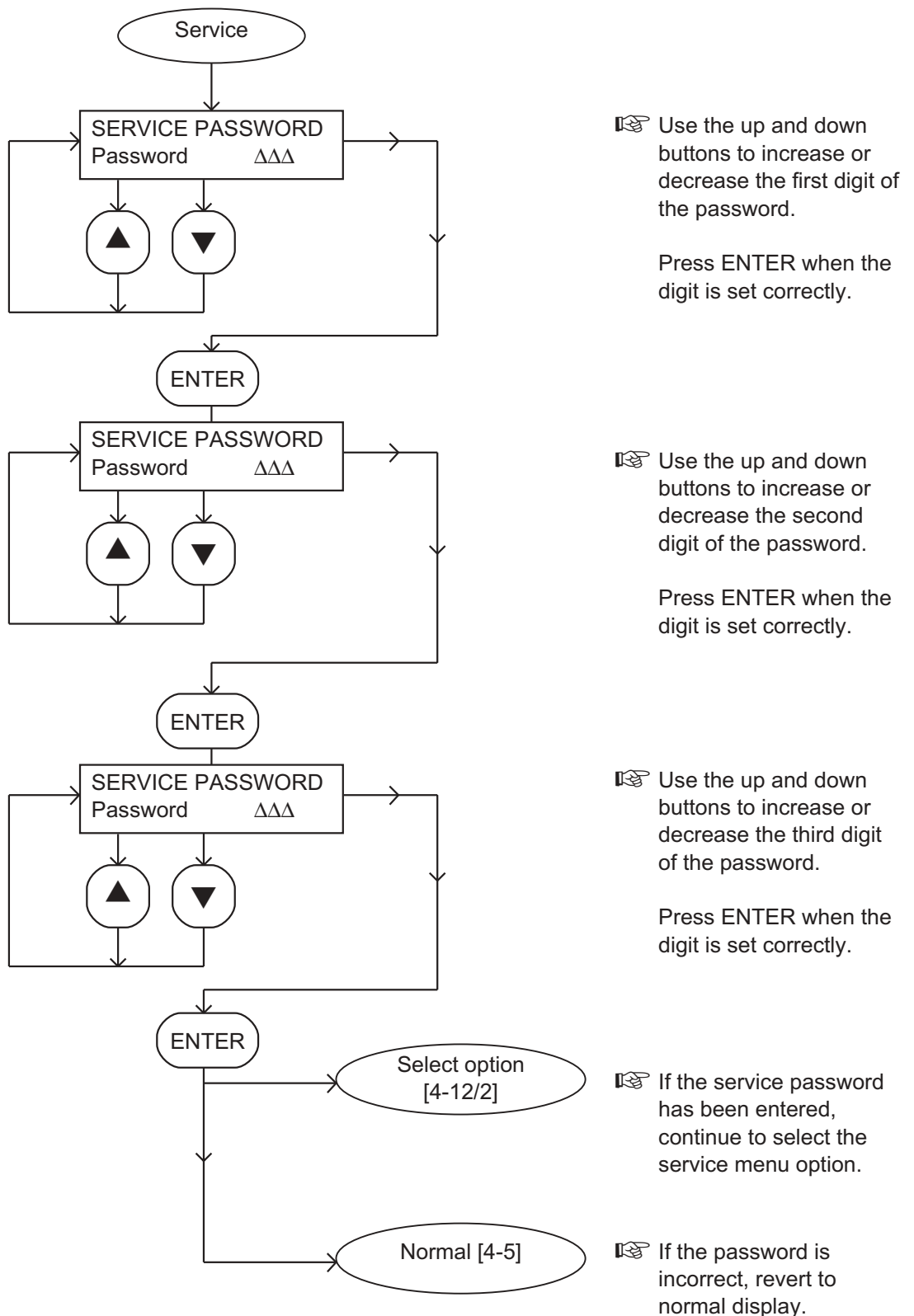


Figure 4-11 - Normal display menu



Use the up and down buttons to increase or decrease the first digit of the password.

Press ENTER when the digit is set correctly.

Use the up and down buttons to increase or decrease the second digit of the password.

Press ENTER when the digit is set correctly.

Use the up and down buttons to increase or decrease the third digit of the password.

Press ENTER when the digit is set correctly.

If the service password has been entered, continue to select the service menu option.

If the password is incorrect, revert to normal display.

Figure 4-12 - Service menu: sheet 1 of 2

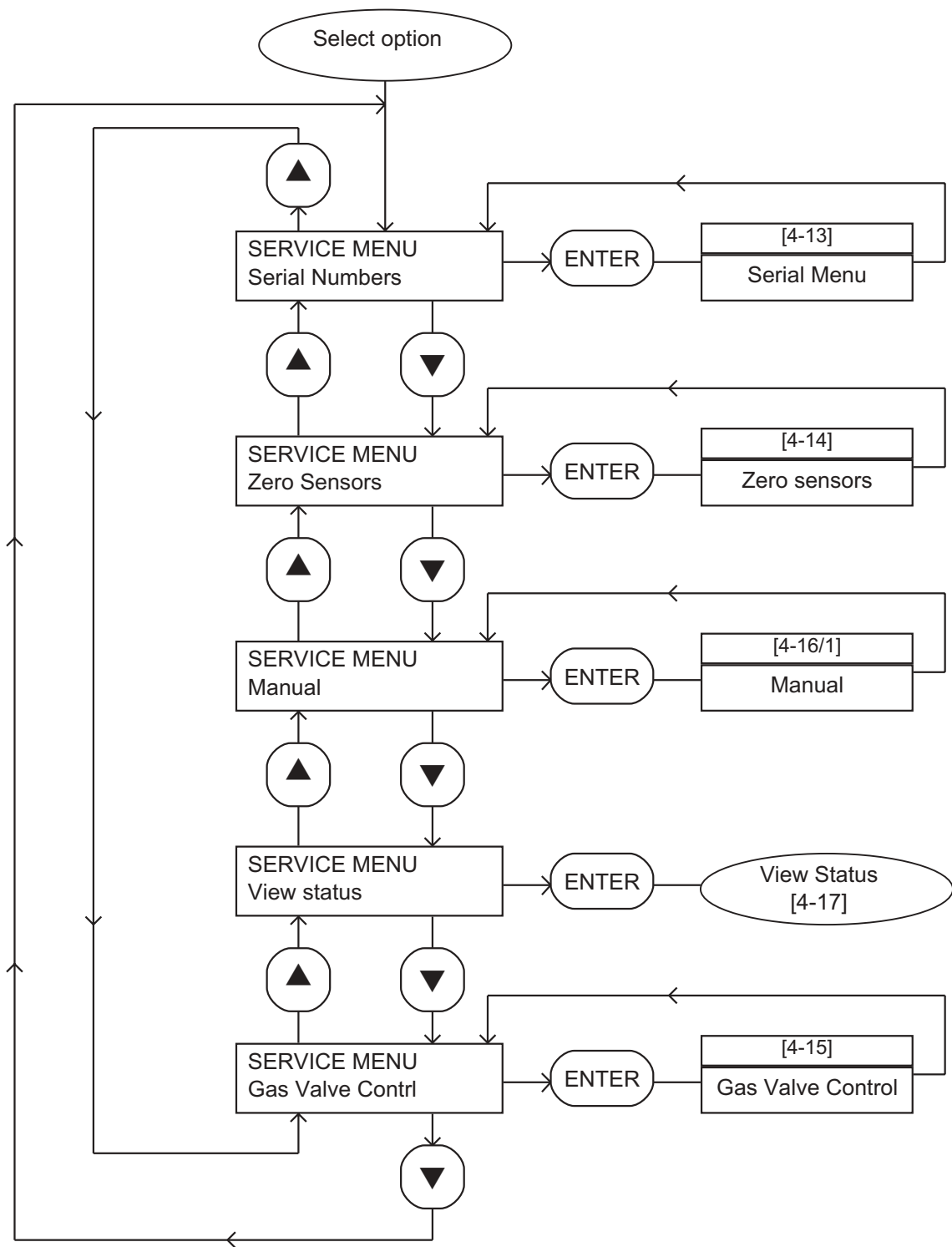


Figure 4-12 - Service menu: sheet 2 of 2

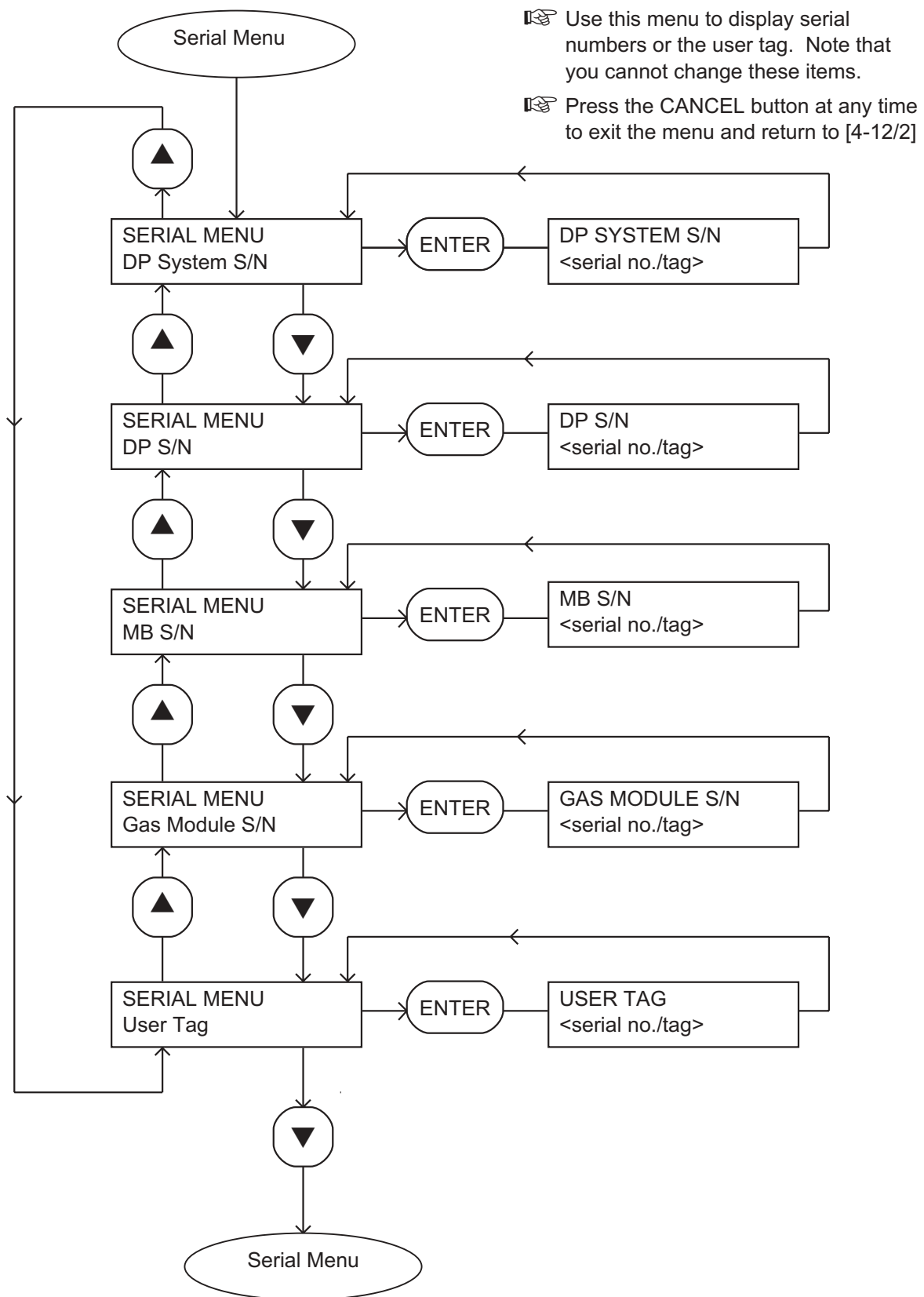


Figure 4-13 - Serial menu

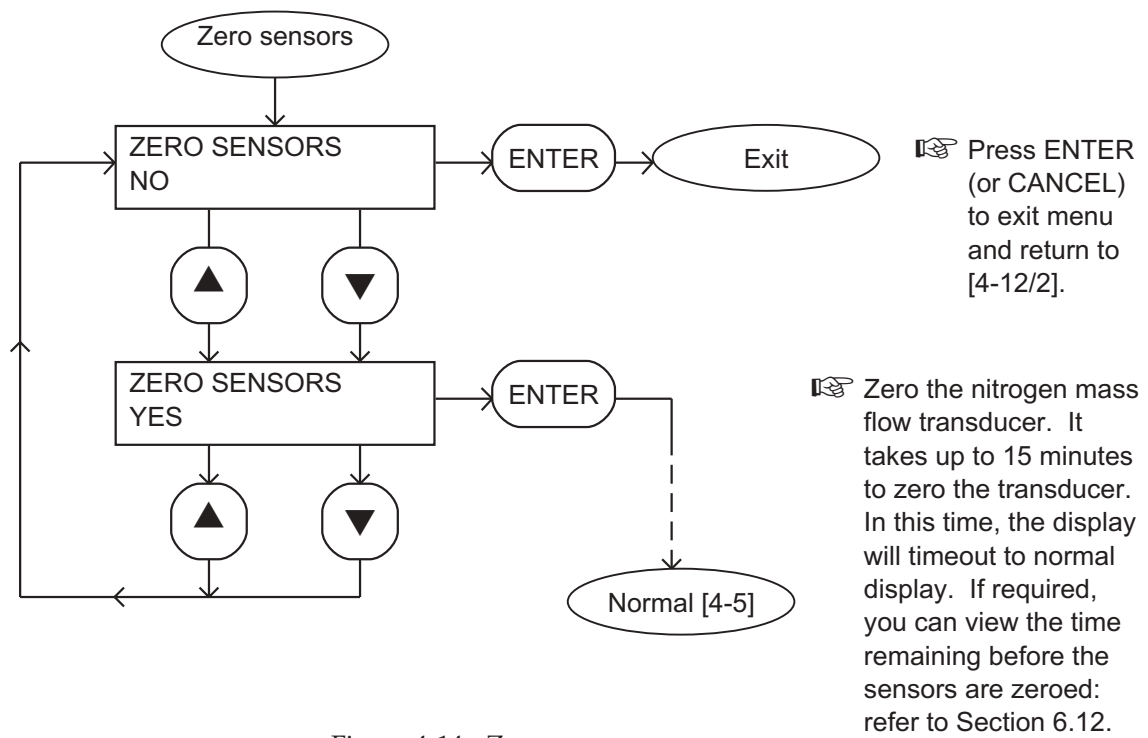


Figure 4-14 - Zero sensors menu

Notes: You should only use this menu if you have been suitably trained by BOC Edwards Service Personnel. If necessary, contact BOC Edwards or your supplier to arrange suitable training.

The actual values displayed depend on the build standard of your system (as identified by its serial number). Contact BOC Edwards if you are unsure what values should be displayed for your system.

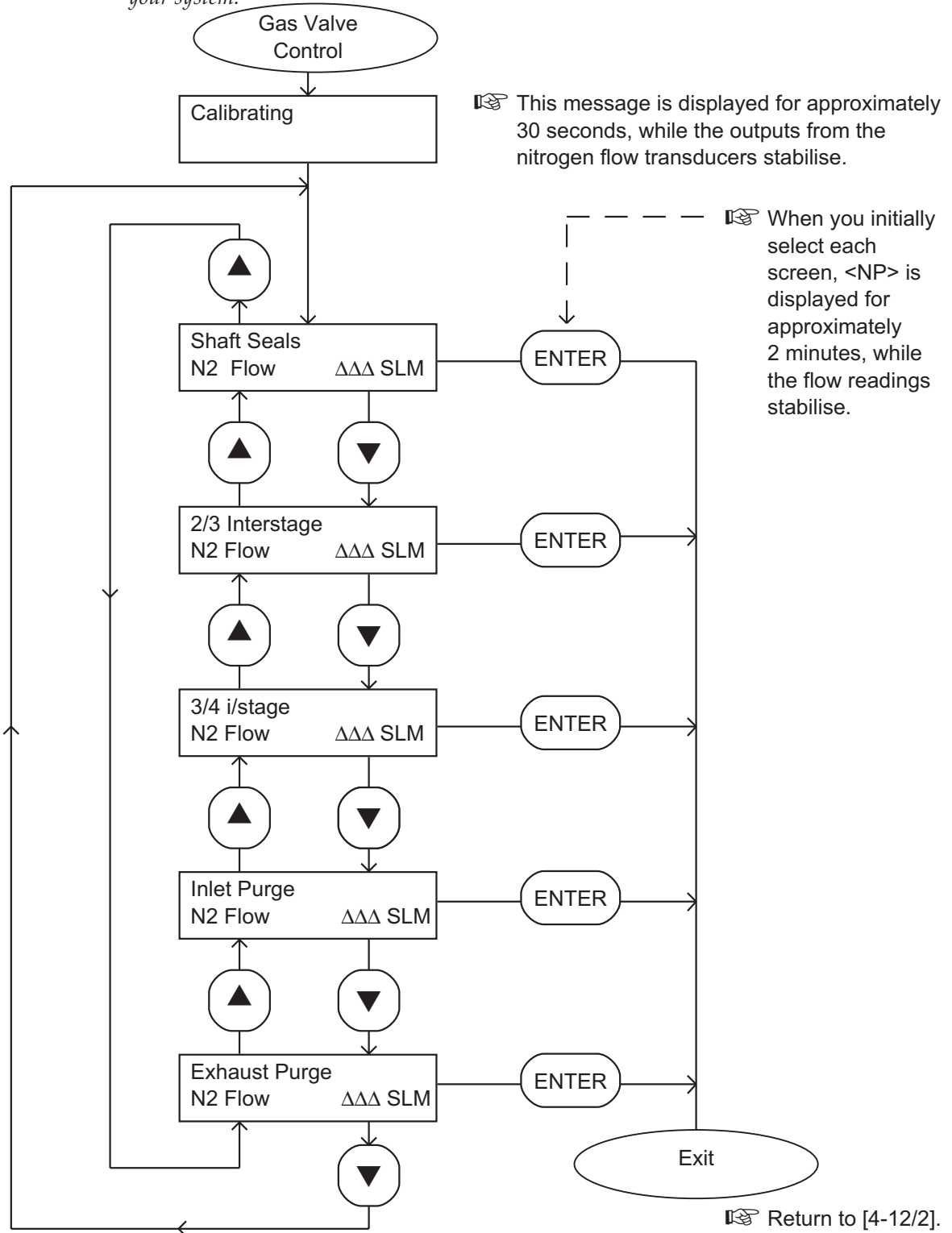


Figure 4-15 - Gas valve control menu

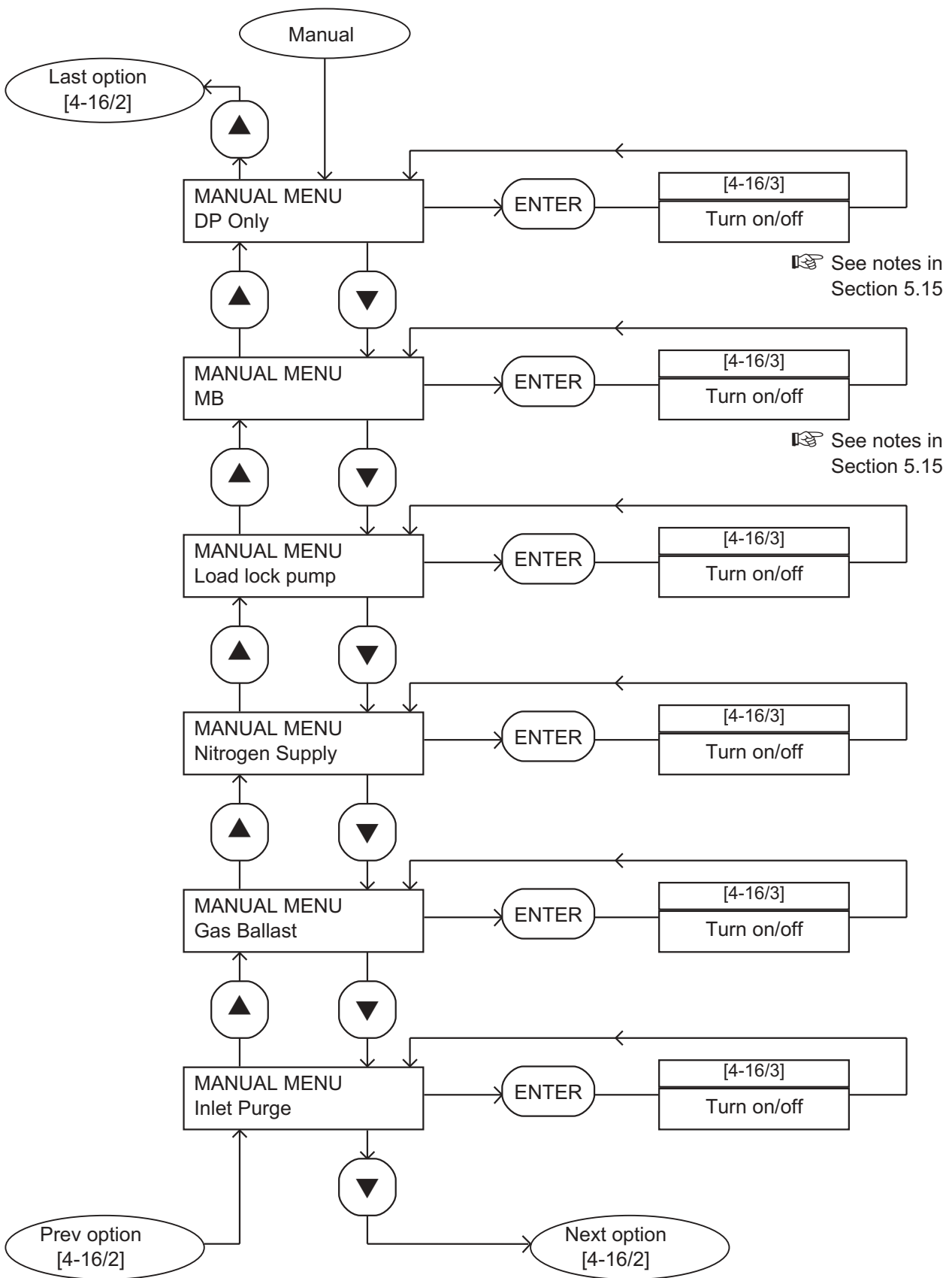


Figure 4-16 - Manual menu: sheet 1 of 3

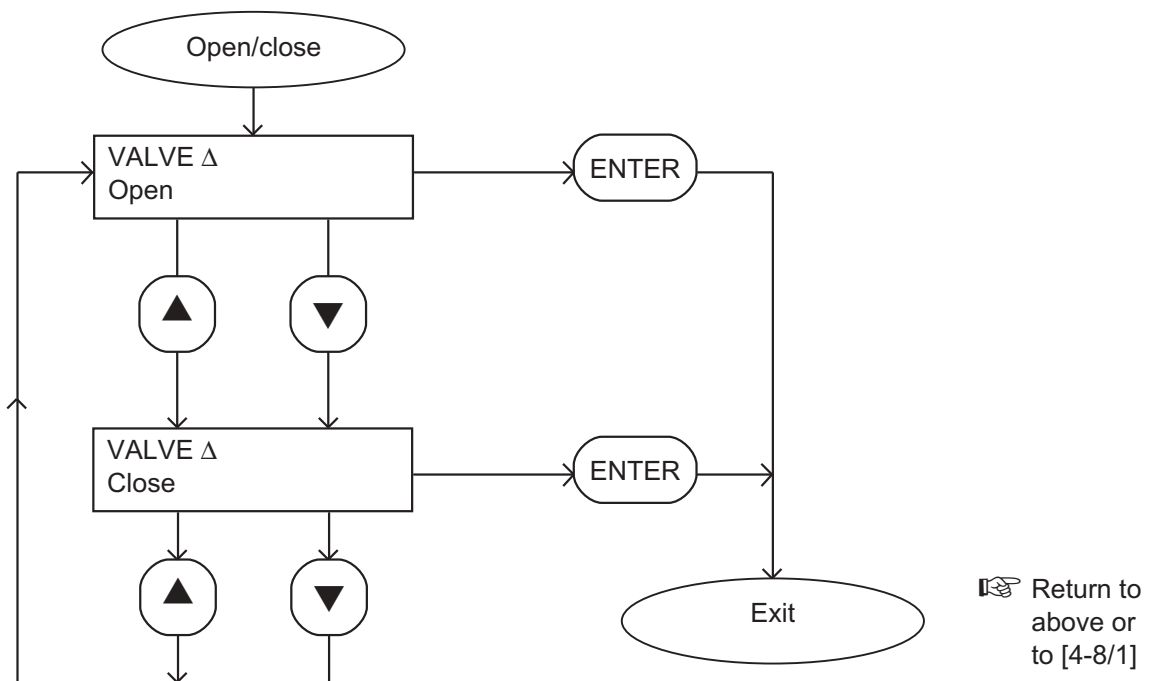
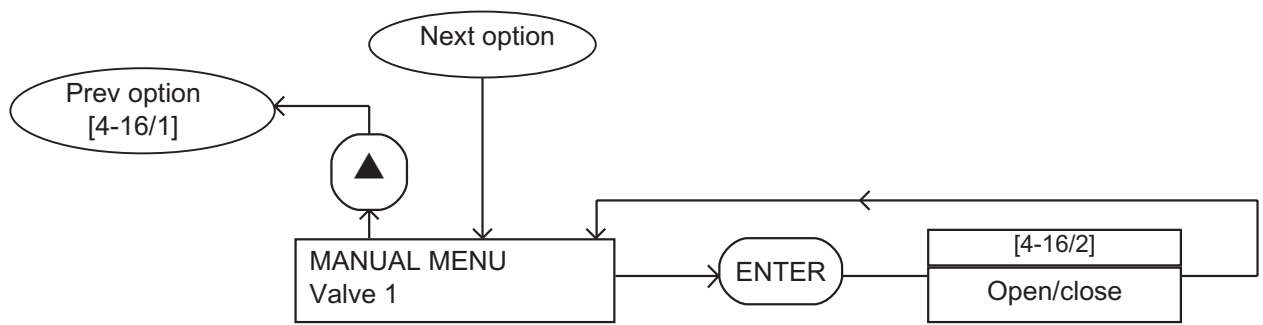


Figure 4-16 - Manual menu: sheet 2 of 3

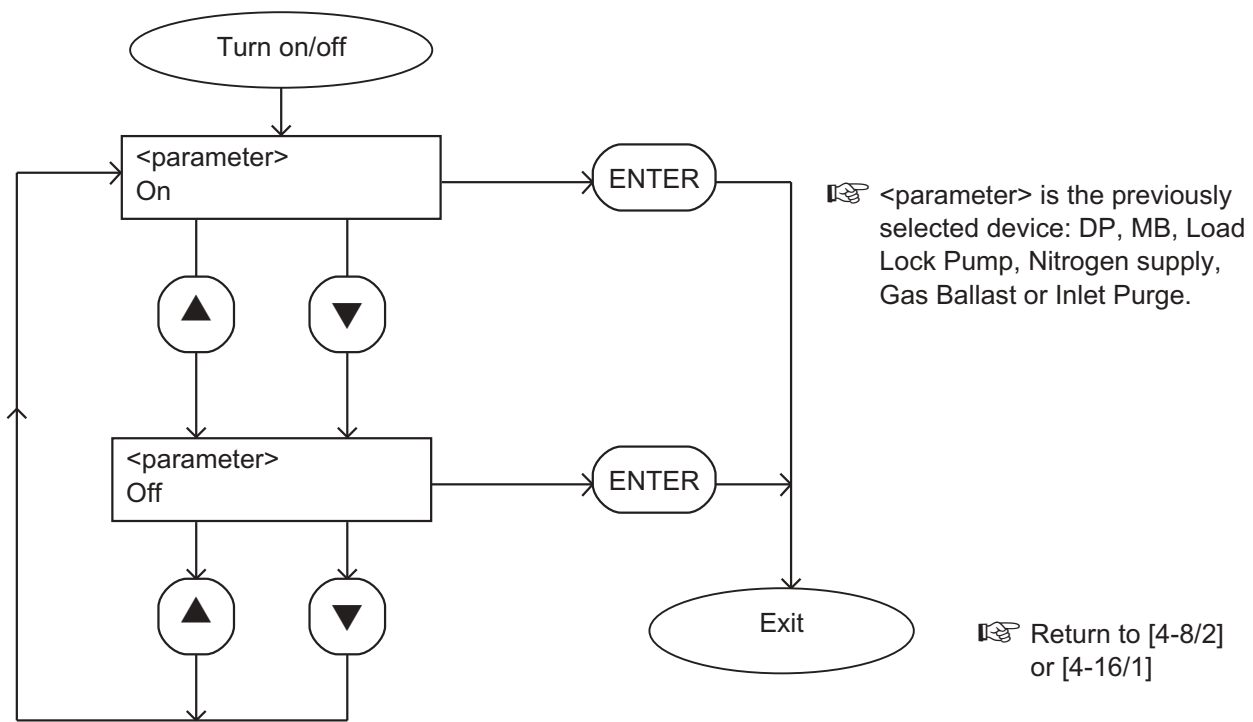


Figure 4-16 - Manual menu: sheet 3 of 3

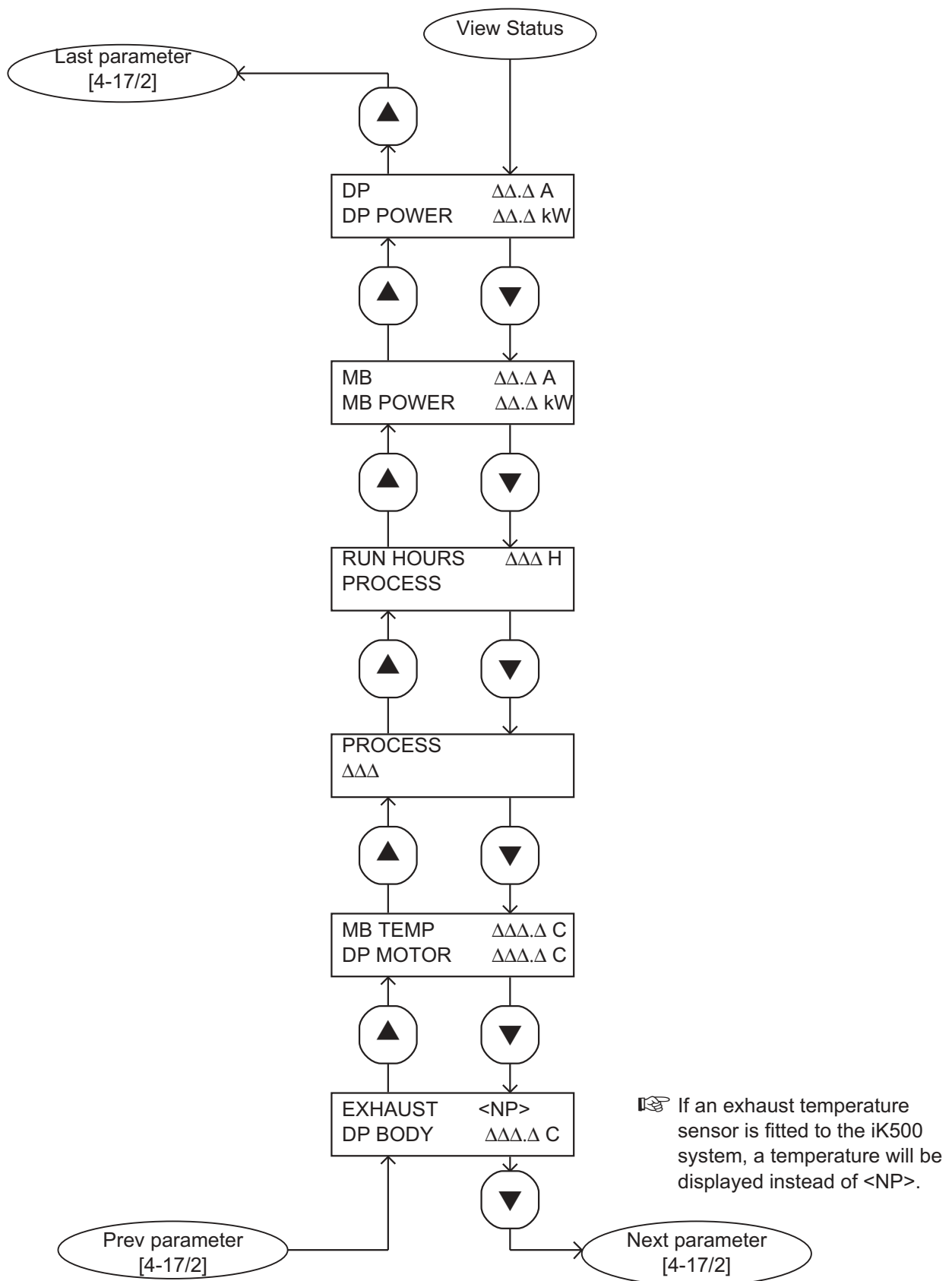


Figure 4-17 - View Status menu: sheet 1 of 2

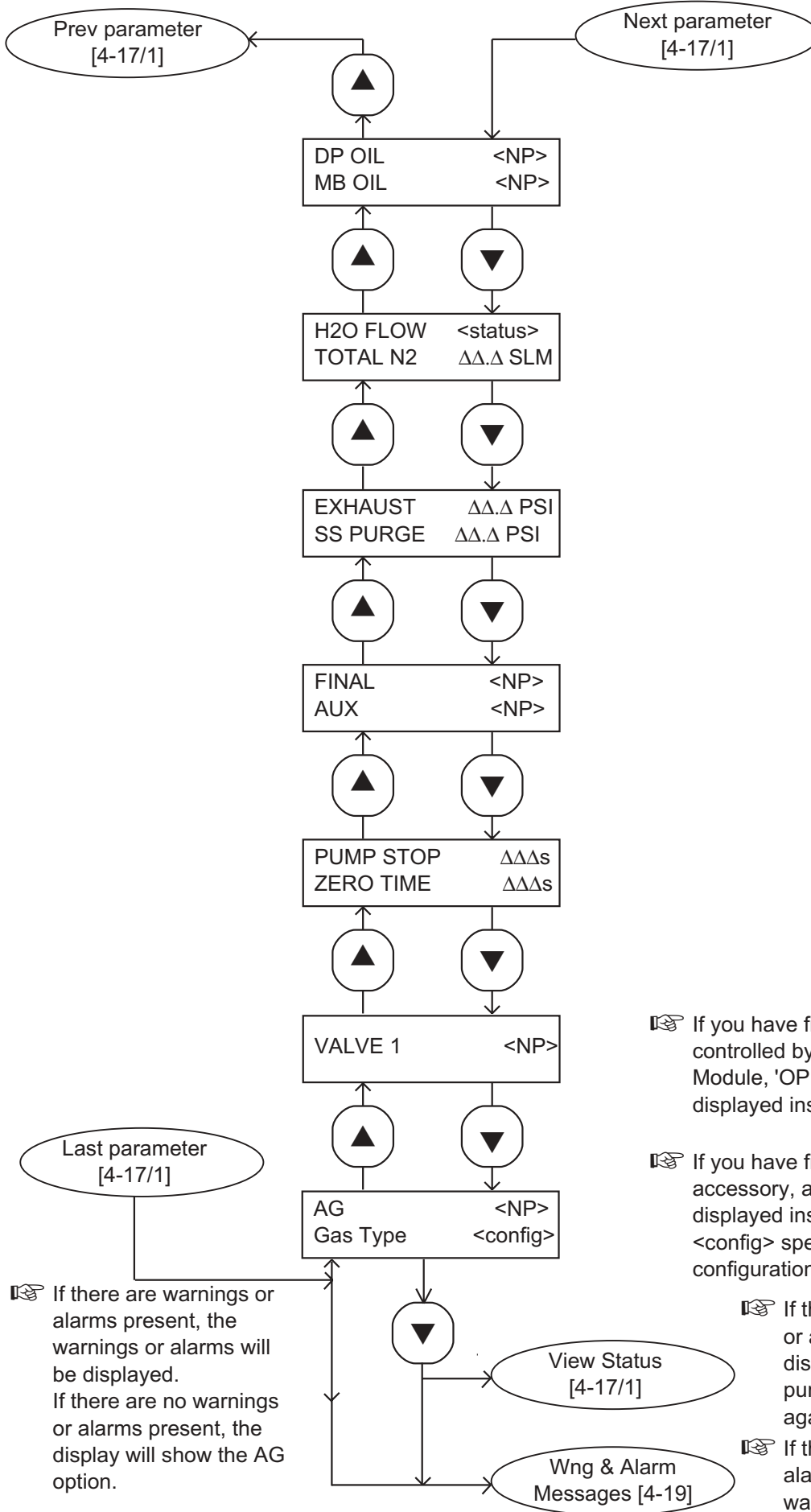


Figure 4-17 - View Status menu: sheet 2 of 2

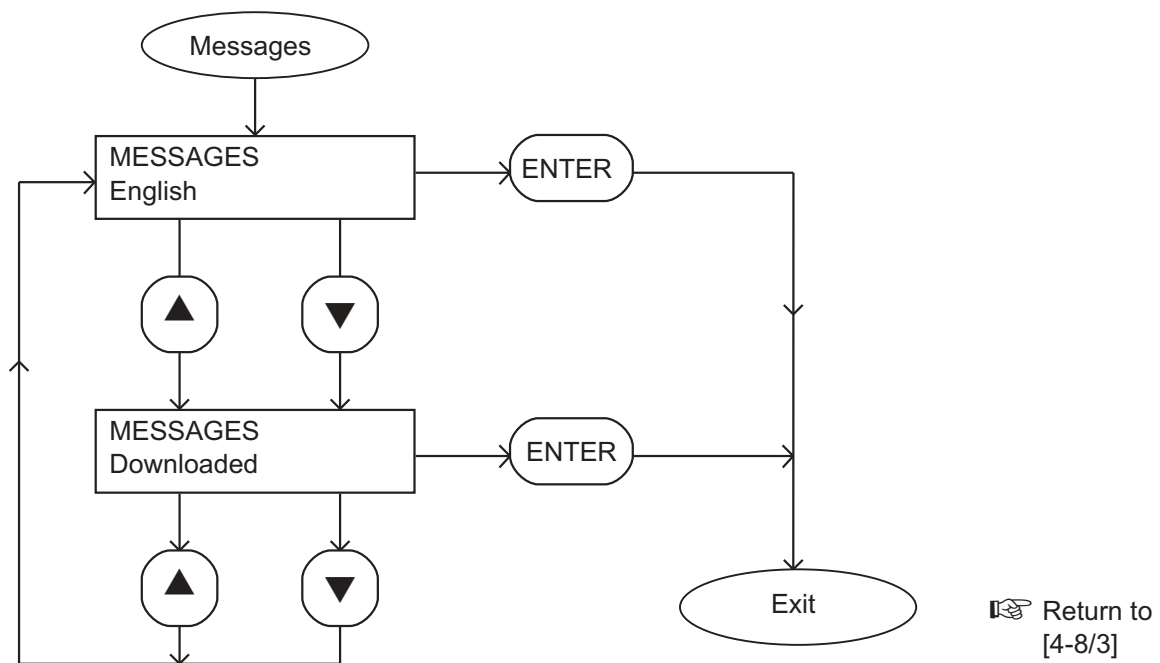


Figure 4-18 - Messages menu

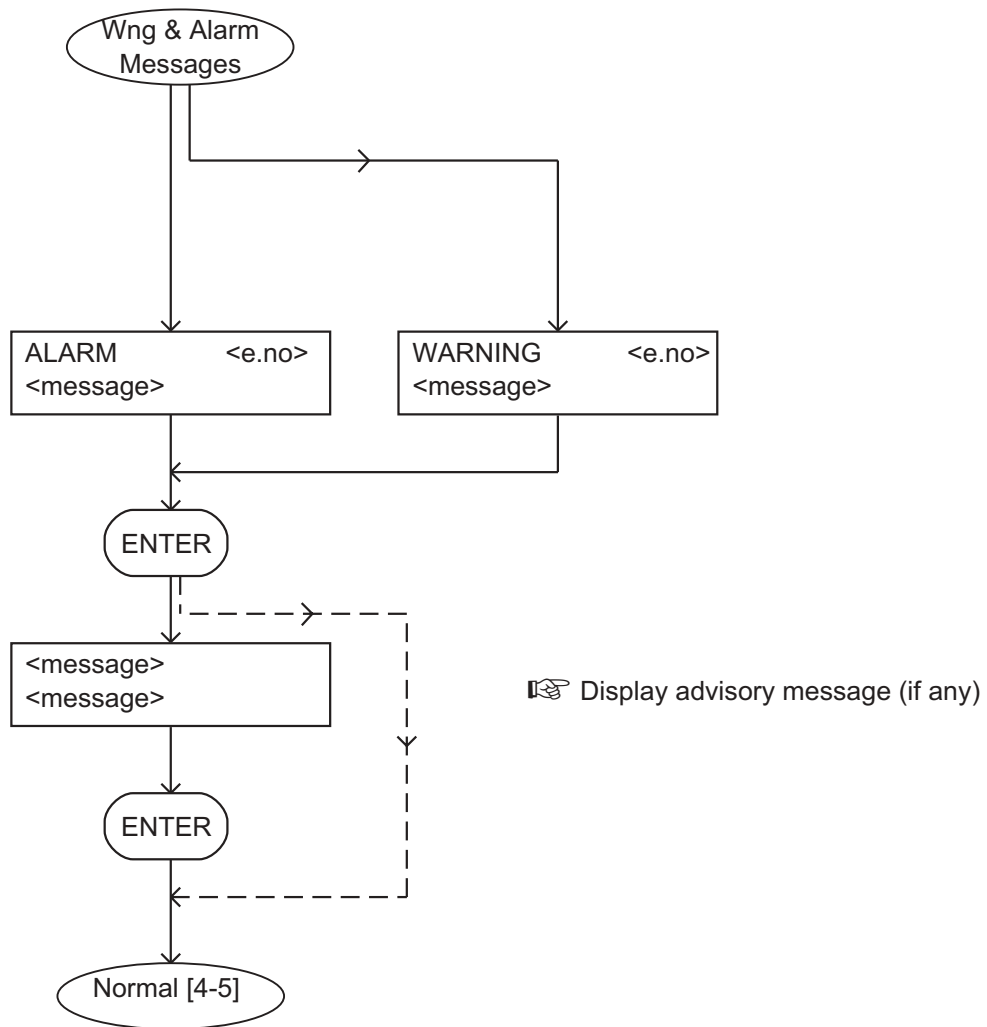


Figure 4-19 - Warning and alarm messages menu

5 OPERATION

5.1 Introduction

The following sections describe the use of the Pump Display Terminal to operate the iK500 system. For a description of the use of an Interface Module or Communications Module accessory to operate the iK500 system, refer to the instruction manual supplied with the Module. For a description of the operation of the load-lock pump (if you have connected the iK500 system to the load-lock pump through an Interface Module), refer to Section 5.16.

The following sections summarise the use of the menus in the Pump Display Terminal. We refer to menus such as 'the Setup/Service/Configuration menu'. Refer to Figure 1-8 or 4-1: this means that you:

- Press the Setup button (7) to select the Setup menu.
- Use the up and down buttons (5, 3) to show the Service option and press ENTER (6) to select the Service menu.
- Use the up and down buttons (5, 3) to show the Configuration option and press ENTER (6) to select the Configuration menu.

We recommend that you fully understand the use of the Pump Display Terminal menus and buttons before you operate the iK500 system. Refer to Section 4 which fully defines the menus, the use of the buttons and the display formats.

Note that you must switch on the electrical supply to the iK500 system before you can use the Pump Display Terminal.

5.2 ATEX directive implications


5.2.1 Introduction

This equipment is designed to meet the requirements of Group II Category 3 equipment in accordance with Directive 94/9/EC of the European Parliament and the Council of 23rd March 1994 on the approximation of the laws of the Member States concerning equipment and protective systems intended for use in potentially explosive atmospheres. (The ATEX Directive)

The ATEX Category 3 applies in respect of potential ignition sources internal to the equipment. An ATEX Category has not been assigned in respect of potential ignition sources on the outside of the equipment as the equipment has not been designed for use where there is an external potentially explosive atmosphere.

There is no potential source of ignition within the pump during normal operation but there may be potential sources of ignition under conditions of predicted and rare malfunction as defined in the Directive. Accordingly, although the pump is designed to pump flammable materials and mixtures, operating procedures should ensure that under all normal and reasonably predicted conditions, these materials and mixtures are not within explosive limits. Category 3 is considered appropriate for the avoidance of ignition in the case of a rare malfunction which allows flammable materials or mixtures to pass through the pump while within their explosive limits.

5.2.2 Flammable/pyrophoric materials

	<p style="text-align: center;">WARNING</p> <p>You must obey the instructions and take note of the precautions given below, to ensure that pumped gases do not enter their flammable ranges.</p>
---	--

When flammable or pyrophoric materials are present within the equipment you must:

- Not allow air to enter the equipment.
- Ensure the system is leak tight.
- Use an inert gas purge (for example, a nitrogen purge) to dilute any flammable gases or vapours entering the pump inlet, and/or use an inert gas purge to reduce the concentration of flammable gases or vapours in the pump and in the exhaust pipeline to less than one quarter of the gases' published lower explosive limits (LEL).
- Use an inert gas purge in to the pump gas ballast connection to prevent the condensation of flammable vapours within the pump mechanism and exhaust pipeline.

5.2.3 Gas purges



WARNING

If you use inert gas purges to dilute dangerous gases to a safe level, ensure that the iK500 pump is shut down if an inert gas supply fails.



WARNING

You must obey the instructions and take note of the precautions given below, to ensure that pumped gases do not enter their flammable ranges.

Switch on the inert gas purge to remove air from the pump and the exhaust pipeline before the process starts. Switch off the purge flow at the end of the process only after any remaining flammable gases or vapours have been purged from the pump and exhaust pipeline.

If liquids that produce flammable vapours could be present in the pump foreline, then the inert gas purge to the iK500 pump should be left on all the time this liquid is present. Flammable liquids could be present in the foreline as a result of condensation, or may be carried over from the process.

When you calculate the flow rate of inert gas required for dilution, consider the maximum flow rate for the flammable gases/vapours that could occur. For example, if a mass flow controller is used to supply flammable gases to the process, you should assume a flow rate for flammable gases that could arise if the mass flow controller is fully open.

Continually measure the inert gas purge flow rate: if the flow rate falls below that required, you must stop the flow of flammable gases or vapours into the pump.

Note: We recommend that you obtain and read the Vacuum Pump and Vacuum System Safety manual (publication number P300-20-000), available from BOC Edwards or your supplier.

5.3 Configure the system (optional)

CAUTION

Ensure that you use the correct configuration setpoints for your application.
If you do not, the iK500 system may be damaged during operation.

Note: If you download a configuration set to the iK500 system, a BOC Edwards engineer must adjust the variable restrictors in the gas system (see Section 1.5) to suit the application. Contact your nearest BOC Edwards Service Centre to arrange this.

If you have a Single Pumpset Monitor connected to the iK500 system, the Monitor contains three configuration sets which contain preset configuration values (for example setpoints) for the iK500 system, for light, medium and process duty applications. Table 5-1 shows the nominal flow rates associated with each of these configuration stores.

You can use the Single Pumpset Monitor to download one of these configuration sets to the iK500 system. Ensure that you use the correct configuration set for your application; contact your supplier or BOC Edwards for advice before you download a configuration set.

Purge gas flow	Nominal flow rates (slm)			
	Low gas configuration store	Medium gas configuration store	Medium gas + exhaust configuration store	High gas configuration store
Shaft-seals purge	4	4	4	4
2/3-interstage purge	-] 10] 10	5
3/4-interstage purge	-			30
Exhaust-purge	-	-	5	5
Total purge	4	14	19	44

Table 5-1 - Configuration store nominal gas flows

5.4 Change the display format

5.4.1 Change the normal display

During normal operation (or whenever the Normal menu is selected), the Pump Display Terminal will show the first page of the normal display. The normal display has two pages and each page can show the readings of one or more sensors or internal clocks or counters. As supplied, the information shown on the first page is:

- HCDP pump power consumption
- HCDP pump-body temperature.

If you press the up or down button, the Pump Display Terminal will then show the second page of normal display; as supplied, the information shown on the second page is:

- QMB pump power consumption
- QMB pump temperature.

If required, you can use the Setup/Normal display menu to change the information shown on the two normal display pages.

5.4.2 Change the display units

If required, you can change the Pump Display Terminal display units:

- Pressures shown on the Pump Display Terminal can be displayed in either kPa or psi. Use the Setup/Units/Pressure menu to change the pressure display units.
- Temperatures shown on the Pump Display Terminal can be displayed in either °C or °F. Use the Setup/Units/Temperature menu to change the temperature display units.
- Pressures measured by an optional Active Gauge connected to the iK500 system, can be shown on the Pump Display Terminal in either mbar, kPa or Torr. Use the Setup/Units/AG menu to change the Active Gauge pressure display units.

5.5 Take and release control

To use the Pump Display Terminal to control the operation of the iK500 system, the Local control LED on the Pump Display Terminal (Figure 1-8, item 9) must be on. If the LED is not on, use the Control menu to take control. You cannot take control with the PDT if another module already has control.

If you need to use another module (for example, the iK500 Interface Module) to operate the iK500 system, the Local control LED on the Pump Display Terminal (Figure 4-1, item 9) must be off. If the LED is on, use the Control menu to release control.

If you use the Pump Display Terminal to start up the iK500 system and you then disconnect the Module from the iK500 for 150 seconds or more, the iK500 system will automatically assume that the Pump Display Terminal has released control; you will then have to use one of the following methods to shut down the iK500 system:

- Take control with the Pump Display Terminal again, then shut down the iK500 system as described in Section 5.10.
- Take control with another module and use that module to shut down the iK500 system.
- Use the emergency stop switch, as described in Section 5.12.

5.6 Start-up



WARNING

Do not operate the iK500 system with any enclosure panels removed and do not touch any parts of the pump(s) when the iK500 system is on. Surfaces of the pump(s) are very hot and can cause injury to people.



WARNING

Ensure that it is safe to start the iK500 system. If you do not (and, for example, maintenance is being performed on components downstream of the iK500 system), you could cause injury to people.

Notes: When you use the Pump Display Terminal to start up the iK500 system, we recommend that you do not disconnect the Module from the iK500 system; if you do, you will not be able to use the Module to instantly shut down the iK500 system: see Section 5.5.

Operation of the iK500 system with high inlet pressure may result in shaft-seal pressure warnings (refer to Table 6-2): the operation of the iK500 system will not be affected, and you can ignore these warnings.

Use the following procedure to start up the iK500 system:

1. Switch on the cooling-water supply, the nitrogen supply and the external electrical supply (if not already on).
2. Ensure that the exhaust-extraction system is not blocked and that valves in the exhaust-extraction system are open.
3. Ensure that the Pump Display Terminal has control of the iK500 system: refer to Section 5.5.
4. Refer to Figure 4-1. Look at the display (2) on the Pump Display Terminal:
 - If there are any warnings or alarms, take the necessary corrective action (refer to Section 6); do not start the iK500 system.
 - If there are no alarms or warnings displayed, use the Switch On menu to switch on the iK500 system.

When you switch on, the following actions will occur (with a small time delay between each action):

- The LED on the On button on the Pump Display Terminal will start to flash.
- The HCDP and QMB pump will be switched on.
- The LED on the On button on the Pump Display Terminal will stay permanently on.
- The solenoid-valve(s) in the Gas Module will open to switch on the nitrogen supplies to the HCDP pump.

5.7 Check the nitrogen pressure and adjust if necessary

Note: You must only check and adjust the nitrogen pressure after the iK500 system has been operating for at least four hours, so that the HCDP pump is at its correct operating temperature.

You **must** check and adjust the nitrogen pressure when you first use the iK500 system. Thereafter, we recommend that you regularly check and adjust the nitrogen pressure, to ensure optimum shaft-seals performance and to maximise the life of the shaft-seals.

When you need to adjust the nitrogen pressure:

- Turn the pressure regulator clockwise to increase the pressure.
- Turn the pressure regulator anticlockwise to decrease the pressure.

Use the following procedure to check and adjust the nitrogen pressure:

1. Use the Setup/Inlet Purge menu to turn off inlet-purge.
2. Use the Setup/Gas ballast menu to turn on gas-ballast.
3. Refer to Figure 1-7. If the pressure low LED (6) and the pressure high LED (5) are both on and the pressure warning LED (3) is off, the nitrogen pressure is correct, otherwise continue at Step 4.
4. Pull up the top of the pressure regulator (4) to unlock it.
5. Adjust the pressure regulator (4) until the pressure high and pressure low LEDs (5, 6) are both on and the pressure warning LED (3) is off. Alternatively, use the Status/SS purge menu to display the nitrogen flow, and adjust the pressure regulator (4) until a pressure of 6.0 psi is displayed.
6. Push down the top of the pressure regulator (4) to lock it.

5.8 Monitor the status of the iK500 system

Notes: If you have selected the Status menu and then do not press any button for five minutes, the display will change to the Normal display: refer to Section 5.4.

If a sensor is not fitted, the corresponding display line will show 'NP' (not present).

Use the Status menu or the Setup /Service/View Status menu to display sensor readings and the values of internal clocks and counters. The information that can be displayed (up to two items of information at a time) is shown in Table 5-2.

5.9 Warning and alarm indications

Notes: Refer to Section 6 for a full list of the warning and alarm messages and their meanings.

Unless you have changed the corresponding setpoints (see Section 5.3), nitrogen purge flow and pressure warning conditions will occur if an iK500 system is operated for extended periods with the inlet pressure close to atmospheric pressure.


If a warning or alarm condition exists:

- The top line of the display on the Pump Display Terminal will change to 'WARNING' or 'ALARM', together with an error number.
- The bottom line of the display will show the warning or alarm message or (for some errors) will be blank.
- The warning or alarm LED on the Pump Display Terminal will flash.

To acknowledge the warning or alarm, press the ENTER button. If the warning or alarm condition has cleared, the warning or alarm LED will go off. If the warning or alarm condition is still present:

- The warning or alarm LED will stay on.
- If the warning or alarm condition does not have an advisory message (see Section 6.18), the display will then change to normal display: see Section 5.4.
- If the warning or alarm condition has an advisory message (see Section 6.18), the display will show two lines which describe a simple check which you can make to identify the cause of the fault and to rectify the fault. When you have read the message, press the ENTER button again; the display will then change to normal display: see Section 5.4.

5.10 Manual shut-down

	<p style="text-align: center;">WARNING</p> <p>If you intend to do maintenance on the iK500 system after you have shut it down and you will not isolate the iK500 system from the electrical supply, do not disconnect the Pump Display Terminal or release control from the Pump Display Terminal (see Section 5.5). If you do, the iK500 system could be started by another Module.</p>
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Notes: Press the Cancel button on the Pump Display Terminal to cancel a shut-down request. The purge time for the Auto shut-down option is preset to 15 minutes as supplied. This purge time can be configured for your application.

Ensure that it is safe to shut down the iK500 system before you select shut-down.

Use the Switch Off menu to shut down the iK500 system. Note that the menu has two shut-down options: Fast and Auto. We recommend that you use the Auto shut-down option. This ensures that the iK500 system is purged with nitrogen for 15 minutes before it is shut down.

When you select Auto shut-down, the following actions will occur (with a small time delay between each action):

- The QMB pump is switched off.
- The LED on the On button on the Pump Display Terminal (Figure 1-8, item 1) starts to flash.
- If not already open, the gas solenoid-valves are opened to switch on the nitrogen purges to the iK500 system.
- After 15 minutes, the gas solenoid-valves are closed to switch off the nitrogen purges to the HCDP pump, and at the same time the HCDP pump is switched off.
- The LED on the On button on the Pump Display Terminal goes off.

If you need to shut down the iK500 system quickly, use the Fast shut-down option. When you select Fast shut-down, the following actions will occur (with a small time delay between each action):

- The QMB pump is switched off.
- The gas solenoid-valves are opened to switch on the nitrogen purges to the HCDP pump.
- After approximately 15 seconds, the gas solenoid-valves are closed to switch off the nitrogen purges to the HCDP pump, and at the same time the HCDP pump is switched off.
- The LED on the On button on the Pump Display Terminal (Figure 1-8, item 1) goes off.

Sensor data	Units	Notes ▼
HCDP pump current consumption	A	
HCDP pump power consumption	kW	
QMB pump current consumption	A	
QMB pump power consumption	kW	
Total running time	hours	Total run-time of the iK500 system.
Process running time †	hours	Total run-time on process.
Process cycles †	-	Process cycles.
iK500 cycles	-	The number of times the iK500 system has been switched on/off.
QMB booster end plate temperature	°C/°F	
HCDP pump-motor water manifold surface temperature	°C/°F	
Exhaust temperature ▲	°C/°F	
HCDP pump body temperature	°C/°F	
Water flow	-	OK indicates the cooling-water flow is acceptable; CHECK indicates that the flow is too low, or that the water flow-switch is faulty or disconnected: see Section 6.
Total nitrogen flow	slm	Total nitrogen flow rate through the Gas Module.
Exhaust pressure	kPa/psi	
Shaft-seals purge pressure	kPa/psi	
Pump stop time	Seconds	
Pump zero time	Seconds	
Valve 1	-	The OPEN/CLOSED state of the gate valve (if an iK500 interface module controlling a gate valve is fitted).
Active gauge pressure ▲	mbar/kPa/Torr	
Gas system configuration	-	"low", "medium", "med+exh" or "high".
Warning/alarm messages #	-	Refer to Section 6 for a list of the messages.

† These display items require signals from the process tool to indicate when the process is on and off, hence these items are only available if you have an iK500 Interface Module.

▲ Only available for display if the appropriate optional accessory is fitted to the iK500 system.

These messages cannot be manually selected to be displayed on the Normal display, but will be automatically displayed on the Normal display when a warning or alarm condition exists.

▼ NP or NR can also be displayed to identify the status of a sensor: refer to Section 4.4.

Table 5-2 - Status menu sensor reading displays

5.11 Automatic shut-down

CAUTION

If you select 'Run til crash', the pump(s) can be damaged and you may invalidate any warranties on the iK500 system equipment.

Notes: The emergency stop button, the emergency stop signal from your control equipment (if fitted) and the safety sensors (see Section 1.11.3) will still shut down the iK500 system, even if you have selected 'Run til crash'.

Use the Setup/Run Til Crash menu to select 'run til crash'.

'Run til crash' is automatically reset to 'off' when the iK500 system is disconnected from the electrical supply, or the electrical supply is switched off.

Normally, if an alarm condition exists, the Electrics Box will shut-down the iK500 system. If required, you can request 'run til crash' operation. In this mode of operation, most alarm conditions will be ignored and the pump(s) will continue to operate. Note however that for safety reasons the following alarms will shut down the iK500 system even if you have selected 'run til crash':

- HCDP CURRENT HIGH/LOW (error numbers 310 and 312).
- HCDP THERMISTOR HIGH (error number 512).
- EXHAUST PRESSURE (error number 3912).
- QMB POWER HIGH/LOW (error numbers 810 and 812).
- QMB PHASE IMBALANCE (error number 1012).

The following alarms will cause only the QMB pump to shut down, whether 'run til crash' is selected or not:

- QMB CURRENT HIGH/LOW (error numbers 710 and 712).
- QMB THERMISTOR HIGH (error number 912).

5.12 Emergency stop

Notes: The emergency stop switch is not an electric isolator, unless the disconnect box accessory is fitted.(See Section 5.17).


The use of the emergency stop will not automatically shut down the load lock pump (if fitted); you must shut down the load lock pump separately.

To shut down the iK500 system in an emergency, press the emergency stop switch (Figure 1-7, item 1) on the dashboard. Alternatively, you can operate the emergency stop controls in your own control system if you have connected your emergency stop circuit to the iK500 system as described in Section 3.15.

When emergency stop is selected:

- The HCDP pump and the QMB pumps, are switched off.
- The solenoid-valve(s) in the Gas Module close, to switch off the supply of nitrogen to the HCDP pump.
- The Pump Display Terminal will display 'STOP ACTIVATED'.
- The LED on the On button on the Pump Display Terminal (Figure 1-8, item 1) will go off.

5.13 Restart the QMB pump after automatic pump shut-down

	<p style="text-align: center;">WARNING</p> <p style="text-align: center;">If a pump is automatically shut down, ensure that it is safe to restart before you restart the pump.</p>
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If the QMB pump has been automatically shut down due to an alarm (see Section 5.11), use the Switch On/Booster Pump menu to restart the QMB pump after the alarm condition has cleared.

5.14 Restart the iK500 system after emergency stop or automatic shut-down



WARNING

If a pump is automatically shut down, ensure that it is safe to restart before you restart the pump.

Note: If the iK500 system has automatically shut down because of high HCDP pump power (alarms 412 and 512), check that the HCDP pump is free to rotate before you restart the iK500 system: refer to Section 6.18.

If you have used the emergency stop switch on the dashboard to shut down the iK500 system, you must reset the emergency stop switch before you can restart the iK500 system. Turn the emergency stop switch to reset it, then restart the iK500 system as described in Section 5.6. Note that the 'STOP ACTIVATED' alarm message (see Table 6-3) will stay on the Pump Display Terminal until you restart the pumping system. See Section 5.17 for details of restarting the system if the disconnect box is fitted.

If the iK500 system has been automatically shut down because of an alarm condition, the alarm condition must be rectified before you can restart the iK500 system. For example, if the iK500 system has been shut down because the HCDP pump-body is too hot, the pump-body must be allowed to cool before you can restart the iK500 system. Restart the iK500 system as described in Section 5.6.

5.15 Operation of iK500 system components



WARNING

Ensure that it is safe to start the iK500 system. If you do not (and, for example, maintenance is being performed on components downstream of the iK500 system), you could cause injury to people.

CAUTION

Do not operate the QMB pump unless the HCDP pump is on.
If you do, you may damage the iK500 system.

CAUTION

Ensure that you do not over-pressurise the vacuum system if you switch on purge gas flow when the pumps are not on.

Note: The gate valve must be connected to the iK500 system through an iK Interface Module with an Auxiliary Interface Card.

Note: When you manually start the HCDP pump or the QMB pump, the pump will only operate for 10 seconds and will then automatically be switched off again.

Note: Although you can select and use the setup/service/manual/MB menu, this will have no effect on the QMB pump; that is you cannot use the menu to manually switch the QMB pump on and off.

In normal operating conditions, the components of the iK500 system are operated automatically.

If necessary (for example, for fault finding purposes), you can control the operation of iK500 system components separately:

- Use the Setup/Service/Manual/Gas Module menu to control the operation of the Gas Module (that is, turn the nitrogen supply, gas-ballast and inlet-purge flows on and off).
- Use the Setup/Service/Manual/Valve menu to control the operation of the gate valve (that is open or close the valve).
- Use the Setup/Service/Manual/DP Only menu to control the operation of the HCDP pump (that is, switch the HCDP pump on and off).

5.16 Operation of the load-lock pump

Note: Operation of the iK500 system with high inlet pressure may result in shaft-seal pressure warnings (refer to Table 6-2): the operation of the iK500 system will not be affected, and you can ignore these warnings.

If you have connected a load-lock pump to the iK500 system through an Interface Module, you can use the following menus to control the operation of the load-lock pump:

- Switch On.
- Switch Off.
- Setup/Service/Manual/Load lock pump.

5.17 Disconnect Box and Photohelic Switch/Gauge (accessories)


Operation of the pumping system with the disconnect box and photohelic switch/gauge is described in the following sections. If the photohelic switch/gauge is not installed, all references to it should be ignored.

The following sections assume that the disconnect box and photohelic switch/gauge (if fitted) have been correctly installed and that the pump and accessories have been installed with reference to their own instruction manuals.

5.17.1 Normal startup

- Ensure that the door is closed and secured before operating the disconnect box.
- Press the DRY PUMP POWER ON/RESET push button on the disconnect box control panel.
- Control and monitoring of the system is now enabled through the Pump Display Terminal (refer to the iH or iQDP manual for operating instructions).

5.17.2 Restart After Fault

	<p style="text-align: center;">WARNING</p> <p>The disconnect box will remain live even with the door open. Do not attempt any servicing in the box before you have isolated the incoming supply.</p>
---	---

Press the DRY PUMP POWER ON/RESET push button on the disconnect box control panel.

5.17.3 Shutdown

The system can be shutdown in four ways through the disconnect box: local EMO; remote EMO; photohelic gauge in warning state, or; brownout condition over 3 seconds. The following sections describe each of the shutdown methods.

5.17.4 Local EMO

Press the EMO push button on the control panel to shut the system down. It will be necessary to reset the push button by twisting until it releases, prior to system restart. The system power can be enabled by pressing the DRY PUMP POWER ON/RESET push button on the disconnect box control panel.

5.17.5 Remote EMO

The system can be shutdown by a remote EMO signal generated from the pump through the 6-way XLR connector. The system power can be enabled by pressing the DRY PUMP POWER ON/RESET push button on the disconnect box control panel.

5.17.6 Photohelic Gauge


The system can be shutdown if the photohelic gauge registers a warning condition. The system power can be enabled by pressing the DRY PUMP POWER ON/RESET push button on the disconnect box control panel.

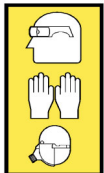
5.17.7 Brownout

The system can be shut down if a brownout occurs for greater than 3 seconds. For brownouts of less than 3 seconds, the system will continue running normally (time delay relay TDR1). The system power can be enabled by pressing the DRY PUMP POWER ON/RESET push button on the disconnect box control panel.

6 MAINTENANCE

6.1 Safety

	<p style="text-align: center;">WARNING</p> <p>Obey the safety instructions given below and take note of appropriate precautions. If you do not, you can cause injury to people and damage to equipment.</p>
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	<p style="text-align: center;">WARNING</p> <p>Hazardous chemicals are located within the pumps and piping. Use of suitable protective gloves and clothing along with respirator is recommended if contact with substances is anticipated.</p>
---	--

- A suitably trained and supervised technician must maintain the iK500 system.
- Ensure that the maintenance technician is familiar with the safety procedures which relate to the products pumped. Wear the appropriate safety-clothing when you come into contact with contaminated components. Dismantle and clean contaminated components inside a fume-cupboard.
- Fit a suitable blanking plate on the iK500 system inlet and your vacuum system as soon as you disconnect the iK500 system from your vacuum system. Do not operate the iK500 system unless the inlet blanking plate is fitted or the iK500 system is connected to your vacuum system.
- Fit a suitable blanking plate on the iK500 system exhaust and your exhaust-extraction system as soon as you disconnect the iK500 system from your exhaust-extraction system. Do not operate the iK500 system unless the exhaust is connected to your exhaust-extraction system.
- Allow the pumps to cool to a safe temperature before you fit lifting bolts or start maintenance work.
- Vent and purge the iK500 system with nitrogen before you start any maintenance work.
- Isolate the iK500 system and other components in the process system from the electrical supply so that they can not be operated accidentally. Note that the emergency stop switch on the iK500 system is **not** an electrical isolator, unless a disconnect box is installed.
- Recheck the pump rotation direction if the electrical supply has been disconnected.
- Do not reuse 'O' rings.
- Dispose of components, grease and oil safely (see Section 7.2).
- Take care to protect sealing-faces from damage.

- Do not touch or inhale the thermal breakdown products of fluorinated materials which may be present if the iK500 system has been overheated to 260 °C and above. These breakdown products are very dangerous. Fluorinated materials in the iK500 system may include oils, greases and seals. The iK500 system may have overheated if it was misused, if it malfunctioned or if it was in a fire. BOC Edwards Material Safety Data Sheets for fluorinated materials used in the pump are available on request: contact your supplier or BOC Edwards.
- Leak-test the system after maintenance work is complete if you have connected or disconnected any vacuum or exhaust joints; seal any leaks found.
- Wipe up any water spilt during maintenance to avoid possible risk of slips.
- Route and secure cables, hoses and pipe-work during maintenance to avoid possible risk of trips.

Material Safety Data Sheets for BOC supplied chemicals can be attained by contacting: UK +44 (0) 1293 528844; France +331 (1) 47 98 24 01; Germany +49 (0) 6421 8030, or; USA (transportation emergency) +1 800-424-9300 (other inquiries) +1 800-848-9800.

6.2 Correct use of Tube fittings

Note: We recommend that you use a second spanner to hold the connector in position when you connect or disconnect a tube fitting.

You must know how to correctly fit and tighten tube fittings in order to prevent gas leaks; use the procedures in the following sections.

6.2.1 Fit a Tube fitting

1. Refer to Figure 6-1 detail A. Undo and remove the nut (4) from the tube fitting (1). Ensure that the front (tapered) ferrule (2) and the rear ferrule (3) are correctly orientated as shown in detail A, then loosely refit the nut (4) to the tube fitting (1).
2. Refer to detail B. Insert the tube (5) through the nut (4) and into the tube fitting (1). Ensure that the tube rests firmly on the shoulder inside the fitting, and that the nut (4) is finger tight.
3. Tighten the nut (4) until you cannot rotate the tube (5). If you cannot turn the tube because of how it is installed, tighten the nut by $\frac{1}{8}$ th of a turn.
4. Refer to detail C. Mark the nut (4) at the six o'clock position.
5. Refer to detail D. Hold the body of the connector steady, then turn the nut (4) by $1\frac{1}{4}$ turns (to the nine o'clock position) to fully tighten the connection.

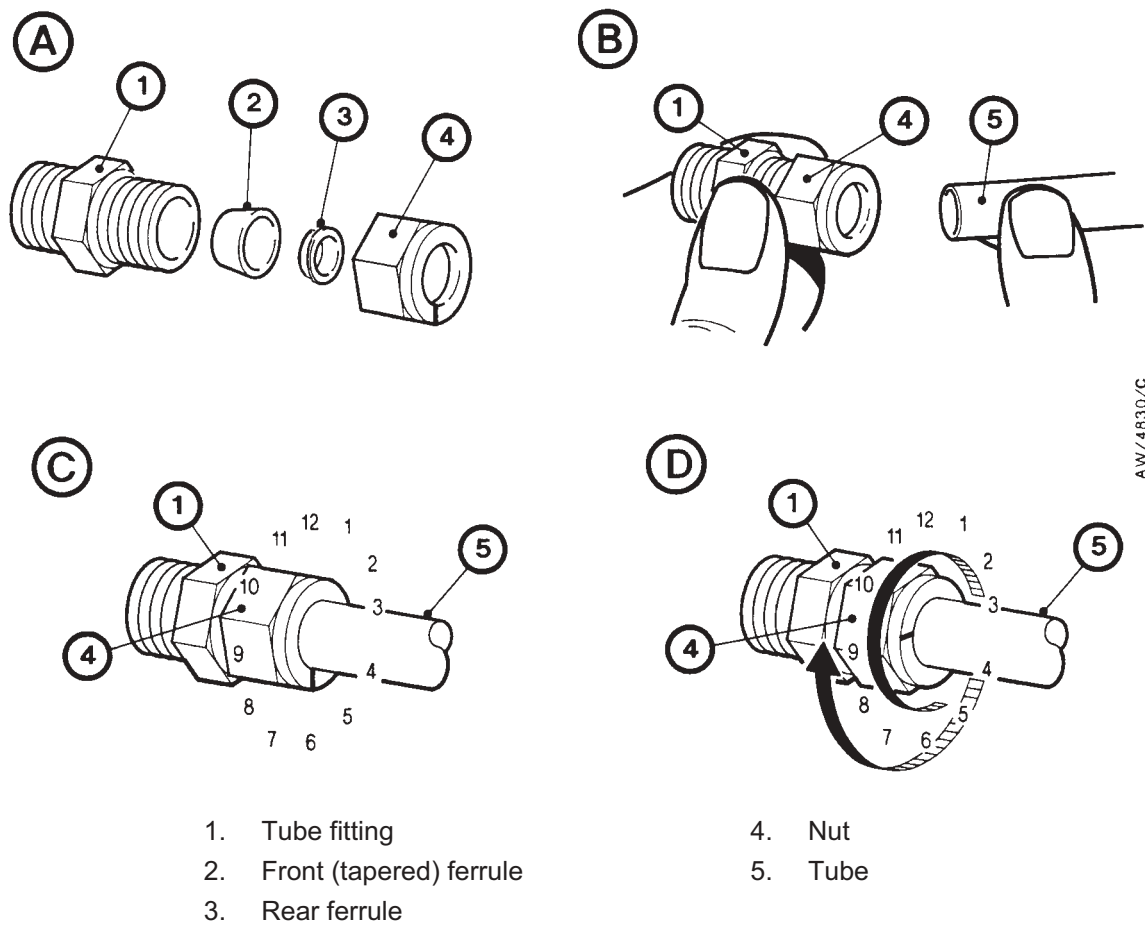


Figure 6-1 - Fit a Tube fitting

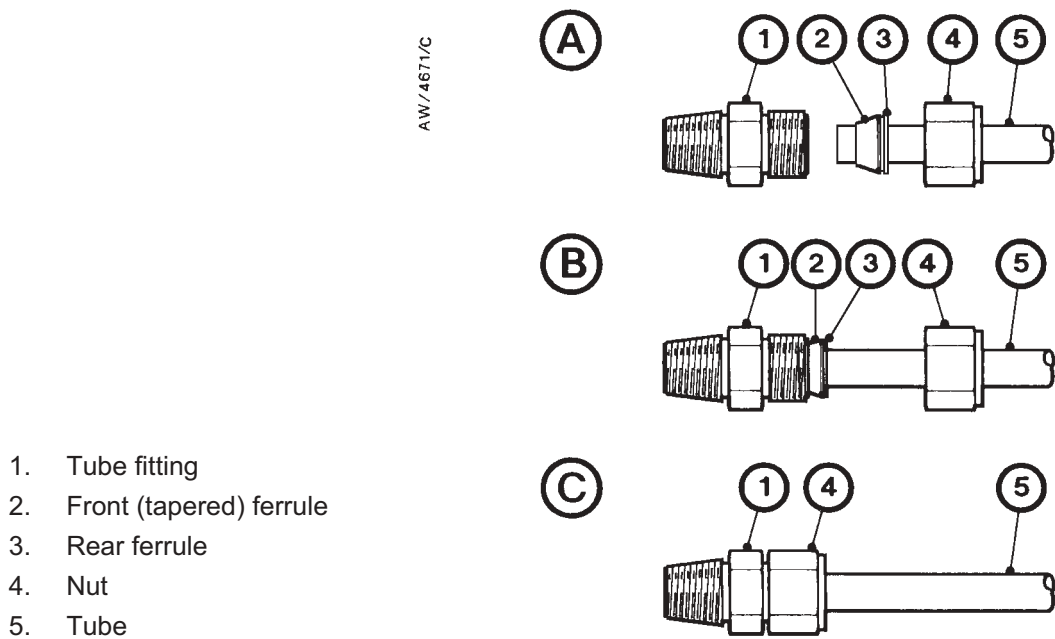


Figure 6-2 - Retighten a Tube fitting

6.2.2 Reconnect a Tube fitting

You can disconnect and reconnect a tube fitting many times and still obtain a correct leak-proof seal. Refer to Figure 6-2 detail A which shows a tube fitting after you have disconnected it. Use the following procedure to reconnect it:

1. Refer to detail B. Insert the tube (5) with the swaged ferrules (2, 3) into the tube fitting (1), until the front ferrule (2) is fully in the body of the fitting.
2. Refer to detail C. Tighten the nut (4) by hand.
3. Use a wrench or spanner to turn the nut (4) to its original position (you will feel an increase in resistance when the nut is in its original position), then tighten the nut slightly.

6.3 Maintenance frequency

The maintenance operations you can carry out are described in the following sections. The frequency of maintenance operations depends on your process. Adjust the frequency of maintenance operations according to your experience.

When you maintain the iK500 system, use BOC Edwards maintenance and service kits. These contain all of the necessary seals and other components necessary to complete maintenance operations successfully.

The plan shown in Table 6-1 details the maintenance operations necessary to maintain QMB pumps in normal use. Instructions for each operation are given in the section shown.

More frequent maintenance may be required if the pump has been used to pump corrosive or abrasive gases and vapours. If necessary, adjust the maintenance plan according to your experience.

Operation	Frequency	Refer to Section
Check the oil-levels	As required	6.7 + 6.8
Inspect the pump connections	Monthly	6.4
Lubricate the rear-bearing	12 monthly	6.11
Change the pump oil	As required	6.9 + 6.10


Table 6-1 - Maintenance plan

6.4 Inspect the connections, pipelines, cables and fittings

Note: Refer to Section 6.2 if you have to connect, disconnect or tighten Tube fittings.

1. Remove the enclosure side and top panels: refer to Section 3.4.
2. Check that all the cooling-water connections are secure; tighten any loose connections. Inspect all cooling-water pipelines, hoses and connections and check that they are not corroded or damaged and do not leak; repair or replace any pipelines, hoses and connections that are corroded or damaged, or which leak.

3. Check that all the nitrogen connections are secure; tighten any loose connections. Inspect all nitrogen pipelines and connections and check that they are not corroded or damaged and do not leak; repair or replace any pipelines and connections that are corroded or damaged, or which leak.

	<p style="text-align: center;">WARNING</p> <p>The substances which accumulate in the exhaust-pipe, elbow and check-valve can be dangerous. Do not allow these substances to come into contact with your skin or eyes. Do not inhale vapours from these substances. Fit blanking caps to the inlet and outlet flanges when you move the exhaust-pipe, elbow or check-valve around your workplace.</p>
---	---

4. Check that all electrical connections are secure; tighten any loose connections. Inspect all electrical cables and connectors for damage; replace any cables and connectors that are damaged.
5. Check that all process and exhaust connections are secure; tighten any loose connections. Inspect all process and exhaust pipelines and fittings and check that they are not corroded or damaged; replace any pipelines or fittings that are corroded or damaged.
6. Refit the enclosure side and top panels: refer to Section 3.17.

6.5 Check the purge gas flow rates

Use the Service/Gas valve control menu to regularly check the purge gas flow rates against the nominal flow rates shown in Table 5-1.

6.6 Inspect and clean the exhaust-pipe, elbow and check-valve

6.6.1 Dismantle, clean and refit the exhaust-pipe and elbow

Note: This requires an iK500 exhaust service kit - Refer to Section 8.3.

Use the following procedure to dismantle, clean and refit the exhaust-pipe and elbow. Refer to Figure 1-1.

1. Remove the NW40 clamp and trapped 'O' ring on the outlet flange of the check-valve (14) to disconnect the iK500 system from your exhaust-extraction pipeline. Dispose of the trapped 'O' ring.
2. Remove the exhaust enclosure (23) by removing the screws connecting to the rear bulkhead cover, drip tray (24) and exhaust enclosure top plate. (See also Figure 3-18).
3. Remove the elbow insulation jacket (20) and clamp insulation jacket (21) and retain.
4. Remove the NW40 clamp and trapped 'O' ring which secures the check valve (14) to the elbow (17) and remove the check-valve. Dispose of the trapped 'O' ring.

5. Remove the NW40 clamp and trapped 'O' ring which secures the elbow to the exhaust pipe (15). Dispose of the trapped 'O' ring.
6. Inspect the exhaust-pipe (15). If you do not need to remove the exhaust-pipe from the pump to clean it, use a suitable tool (for example a long bottle brush) and a cleaning solution suitable for the deposits to clean the exhaust pipe and continue at Step 17. If you need to remove the exhaust-pipe from the pump to clean it, continue at Step 7.
7. Use a hexagonal key to remove the cap screws, which secure the drip tray (24) to the iK500 system. Remove and retain the drip tray.
8. Remove and retain the exhaust insulation jacket (22). Dispose of the stainless steel cable ties.
9. Undo and remove the bracket which secures the exhaust pipe to the iK500 system. Retain the bracket.
10. Use a hexagonal key to remove the four M8 cap-head screws and washers which secure the exhaust pipe (15) to the HCDP pump, then remove the metal 'O' ring and the exhaust-pipe from the HCDP pump. Dispose of the 'O' metal ring.
11. Empty all loose deposits from the exhaust-pipe (15), then use a suitable tool (for example, a long bottle-brush) and a cleaning solution suitable for the deposits to clean the exhaust-pipe.
12. Check that the mating surfaces of the HCDP pump outlet and the inlet flange on the exhaust pipe (15) are not scratched or damaged: if necessary refinish the surfaces. Refit the exhaust insulation jacket to the pipe and secure with new stainless steel cable ties (in kit). Use Figure 6-3 as a guide.
13. Fit a new metal 'O' ring (supplied with kit) to the 'O' ring groove on the flange on the exhaust pipe (15).
14. Use the screws and washers (retained in Step 10) to secure the flange to the HCDP pump outlet and tighten by hand; ensure that the 'O' ring remains correctly in place.
15. Use a torque wrench to alternately and evenly tighten the four screws to a torque of 30 Nm.
16. Use the bracket assembly (removed in step 9) to secure the exhaust pipe (15) to the iK500 system.
17. Inspect the elbow (17). If you do not need to clean the elbow, continue at Step 19. If you do need to clean the elbow, continue at Step 18.
18. Empty all loose deposits from the elbow, then use a suitable tool (for example a long bottle brush) and a cleaning solution suitable for the deposits to clean the elbow.
19. Fit a new NW40 trapped 'O' ring and the NW40 clamp to secure the elbow to the exhaust pipe.
20. Refit the elbow insulation jacket and clamps insulation jacket. Use Figure 6-3 as a guide.
21. Use the cap screws and washers (retained in Step 7) to secure the drip tray (24) to the iK500 system.
22. Continue at Section 6.6.2 to clean and refit the check-valve.

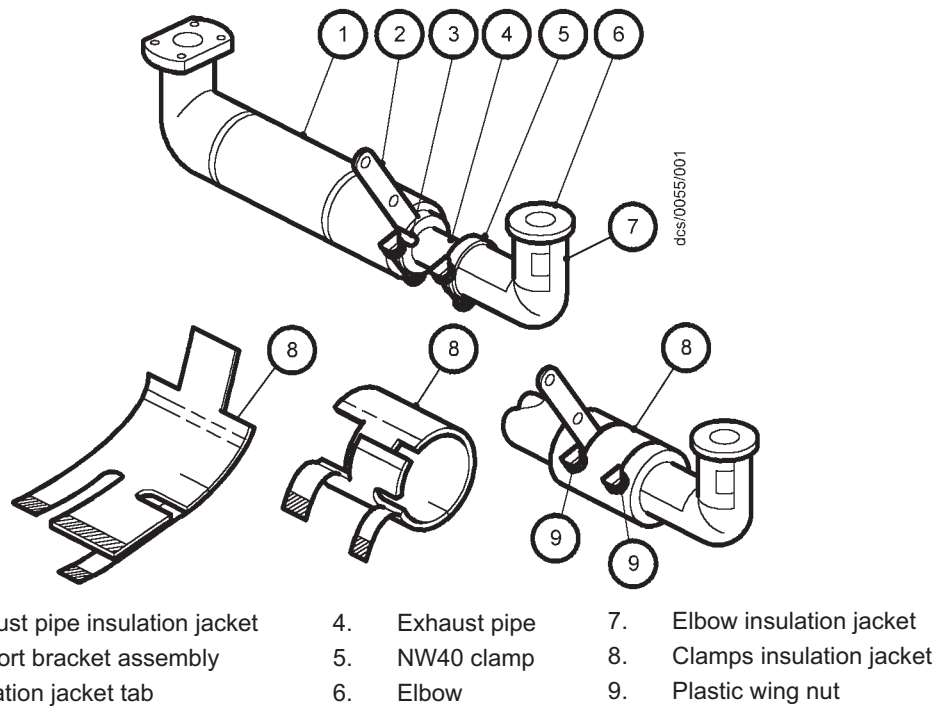
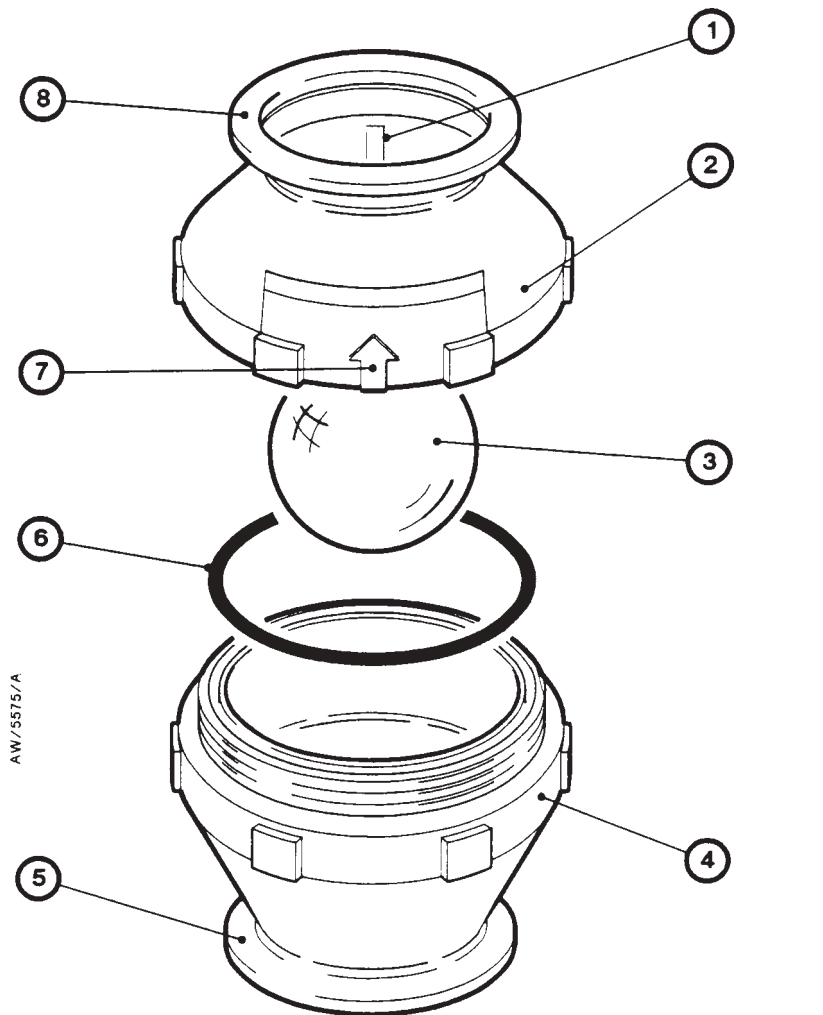


Figure 6-3 - Fit insulation jacket

6.6.2 Clean and refit the check-valve (if fitted)

Note: This requires a check valve service kit - refer to Section 8.3.

1. Refer to Figure 6-4. Unscrew the two halves (2, 4) of the check-valve body (if necessary, use a strap wrench, then remove the fluoroelastomer ball (3) and the 'O' ring (6).
2. Use a cleaning solution suitable for the deposits to clean the valve body and the fluoroelastomer ball. If necessary, replace the fluoroelastomer ball.
3. Inspect the 'O' ring groove and the flange sealing-faces for damage; refinish if necessary.
4. Position the new 'O' ring in its groove in the valve body (4).
5. Ensure that the fluoroelastomer ball (3) is correctly positioned in the valve body, then screw the two halves of the valve body (2, 4) together.
6. Refer to Figure 1-1. use a new trapped 'O' ring (not supplied) and clamp (removed in Section 6.6.1) to secure the check valve (14) to the elbow (17). Ensure that the flow arrow on the check valve (Figure 6-4, item 7) points away from the elbow towards the exhaust extraction system.
7. See Figure 1-1. Refit the exhaust enclosure (23) using the screws connecting to the rear bulkhead cover, drip tray (24) and exhaust enclosure top plate. (See also Figure 3-18).
8. Apply a light wipe of vacuum grease to a new NW40 trapped 'O' ring, then use the trapped 'O' ring and the NW40 clamp (removed in Section 6.6.1) to secure the check-valve outlet to the exhaust-extraction system.



- | | |
|-------------------------|-------------------------|
| 1. Spider leg | 5. Inlet-flange |
| 2. Valve body (female) | 6. 'O' ring |
| 3. Fluoroelastomer ball | 7. Flow direction arrow |
| 4. Valve body (male) | 8. Outlet-flange |

Figure 6-4 - Clean the exhaust check-valve

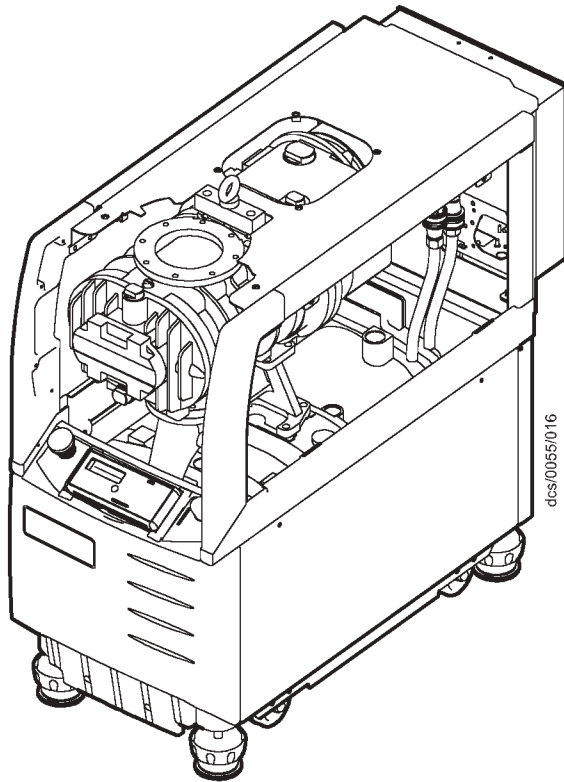
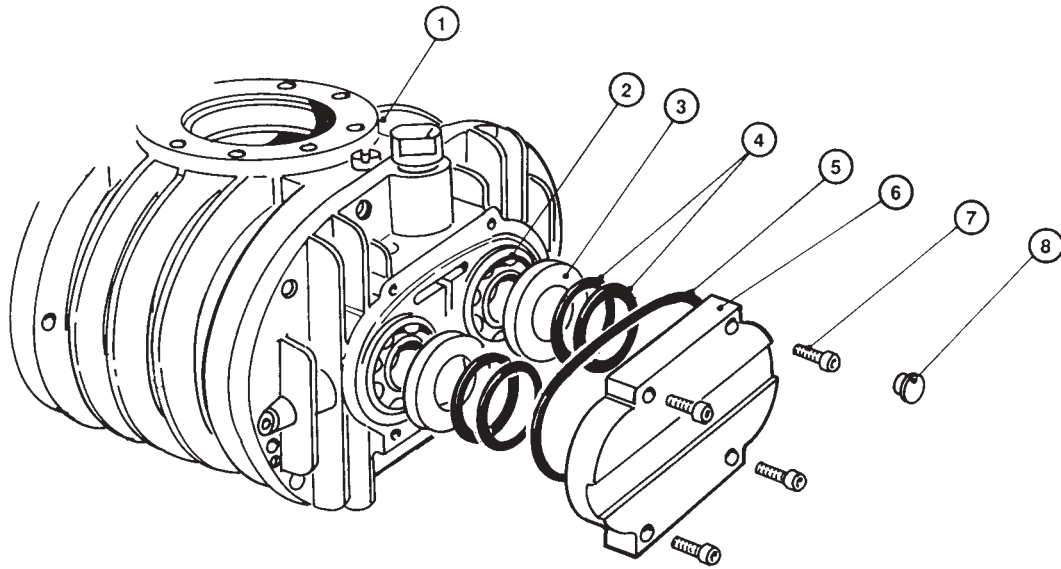


Figure 6-5 - Lubricate the QMB



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- | | |
|--------------|----------------------|
| 1. Pump-body | 5. 'O' ring |
| 2. Bearing | 6. End-cover |
| 3. Spacer | 7. Socket-head screw |
| 4. Shims | 8. Cover-cap |

Figure 6-6 - Lubricate the QMB rear bearing

6.7 Check the QMB pump oil-level



WARNING

The majority of synthetic oils/greases can cause inflammation of the skin (dermatitis). Safety precautions must be taken to prevent prolonged skin contact with these substances. Use of suitable protective gloves and clothing along with respirator is recommended if contact with substances is anticipated.

CAUTION

Do not check the oil-level when the iK500 system is operating. The correct oil-level may not be shown when the pump is operating.

CAUTION

Ensure that the oil-level in the QMB pump is correct. If the pump oil-level is incorrect, pump performance may be affected and the pump may be damaged.

Note: If there is a significant loss of oil from the pump, the shaft-seals may have failed. You cannot replace the shaft-seal. Contact your supplier or a BOC Edwards Service Centre for advice.

Use the following procedure to check the oil-level.

1. Shut down the iK500 system (refer to Section 5.10) and allow it to cool.
2. Remove the right-hand side enclosure panel from the iK500 system: refer to Section 3.4.
3. Refer to Figure 3.5. Check the shaft-seal oil-level. If the oil-level is below the bottom of the reflector plate (6), refer to Section 3.7.2.2 and refill the shaft-seal reservoir.
4. Check the coupling-cover oil-level. If the oil-level is below the top of the reflector plate, refer to Section 3.7.2.1 and refill the coupling-cover reservoir.
5. Refit the right-hand side enclosure panel: refer to Section 3.17.

Refer to Figure 1.3 for the location of the filler-plugs and sight-glasses. During normal operation, the coupling-cover sight-glass (Figure 1.3, item 11) may appear empty or show a froth because the oil is in circulation around the coupling.

6.8 Check the HCDP pump oil-level



WARNING

Do not remove the oil filler-plug while the pump is operating. If you do, hot oil may be ejected from the pump.



WARNING

The majority of synthetic oils/greases can cause inflammation of the skin (dermatitis). Safety precautions must be taken to prevent prolonged skin contact with these substances. Use of suitable protective gloves and clothing along with respirator is recommended if contact with substances is anticipated.

CAUTION

Do not check the oil-level when the iK500 system is operating. The correct oil-level may not be shown when the pump is operating.

CAUTION

Ensure that the oil-level in the HCDP pump is correct. If the pump oil-level is incorrect, pump performance may be affected and the pump may be damaged.

Use the following procedure to check the oil-level.

1. Shut down the iK500 system (refer to Section 5.10) and allow it to cool.
2. Remove the right-hand side enclosure panel from the iK500 system: refer to Section 3.4.
3. Refer to Figure 3-5 detail B. Check that the oil-level is between the MAX and MIN marks on the bezel of the HCDP oil-level sight-glass (16):
 - If the oil-level is above the MAX mark, drain excess oil from the pump as described in Section 6.9 until the oil-level is correct.
 - If the oil-level is below the MIN mark, fill the pump with oil until the oil-level is correct, as described in Section 6.9.
4. Refit the right-hand side enclosure panel: refer to Section 3.17.

6.9 Change the HCDP pump oil



WARNING

Do not remove the oil filler-plug while the pump is operating. If you do, hot oil may be ejected from the pump.



WARNING

The majority of synthetic oils/greases can cause inflammation of the skin (dermatitis). Safety precautions must be taken to prevent prolonged skin contact with these substances. Use of suitable protective gloves and clothing along with respirator is recommended if contact with substances is anticipated.

CAUTION

Ensure that the oil-level in the HCDP pump is correct. If the pump oil-level is incorrect, pump performance may be affected and the pump may be damaged.

1. Shut down the iK500 system (refer to Section 5.10) and allow it to cool.
2. Remove the right-hand side enclosure panel from the iK500 system: refer to Section 3.4.
3. Refer to Figure 1-1. Remove the HCDP oil filler-plug (4).
4. Use a suitable pump or syringe to suck the oil out of the pump.
5. Dispose of the old 'O' ring on the oil filler-plug (4) and replace it with a new 'O' ring (available as a spare: refer to Section 8.3).
6. Fill the pump through the filler hole with the correct grade and quantity of oil. Allow the oil to drain into the pump, then check the oil-level on the sight-glass: refer to Section 6.8.
7. Ensure that the new 'O' ring is correctly positioned on the oil filler-plug (4), then refit the filler-plug to the HCDP pump.
8. Refit the right-hand side enclosure panel: refer to Section 3.17.

6.10 Change the QMB pump oil



WARNING

Ensure that the correct vented filler-plug is replaced in the shaft-seal reservoir. If you use a non-vented plug, the reservoir will be pressurised and the oil sight glass may fracture.

CAUTION

Ensure that the oil-level in the QMB pump is correct. If the pump oil-level is incorrect, pump performance may be affected and the pump may be damaged.

1. Shut down the iK500 system (refer to Section 5.10) and allow it to cool.
2. Remove the right-hand side enclosure panel from the iK500 system and top access panel: refer to Section 3.4
3. Remove the coupling-cover oil filler-plug (Fig. 1-3, item 3).
4. Remove the coupling-cover oil drain-plug (9) from the underside of the coupling-cover and allow the oil to drain into a suitable container.
5. Remove the shaft-seal vented oil filler-plug (2). Use a suitable pump to suck the oil out of the shaft-seal reservoir.
6. Refit the coupling-cover oil drain-plug (9).
7. Refer to Section 3.4 and fill the coupling-cover and shaft-seal reservoir with oil.
8. Refit the coupling-cover oil filler-plug (3) and the shaft-seal vented oil filler-plug (2).
9. Refit the right-hand side enclosure panel: refer to Section (3.17).

6.11 Lubricate the QMB rear-bearing L & top access panel

1. Switch off the pump and isolate it from the electrical supply. Vent the pump to atmospheric pressure. Remove the front cover, refer to Figure 6-5.
2. Refer to Figure 6-6. Remove the four plastic cover-caps (8) from the end-cover (6).
3. Undo and remove the socket-head screws (7) located under the four plastic cover-caps.
4. Remove the end-cover (6) and 'O' ring (5). Dispose of the 'O' ring safely.
5. Note the exact location of the shims (4) and spacers (3) inside the end-cover (6). Clean off all visible grease from the end-cover; take care not to misplace or damage the shims and spacers.
6. Use a clean, lint-free cloth or a plastic or wooden spatula to remove all visible grease from both bearings (2).
7. Fill the visible side of each bearing (2) with clean grease, then lightly force the grease into the bearings.
8. Apply a light wipe of high-vacuum grease to the new 'O' ring (5) and fit it into the groove in the end-cover (6).
9. Check that the shims (4) and spacers (3) are correctly located in the end-cover (6).
10. Fit the end-cover (6) and secure with the four socket-head screws (7). Tighten the screws evenly and refit the plastic cover-caps (8).

6.12 Zero the Gas Module flow transducer

Note: The flow transducer is zeroed by the software in the control system; you do not need to physically adjust any part of the iK500 system.

The accuracy of the mass flow transducer in the Gas Module may drift slightly and we recommend that it is 'zeroed' (that is, calibrated for zero gas flow) once a year.

You must zero the transducer with the electrical supply on, the iK500 system switched off and your nitrogen supply off and disconnected from the iK500 system. This ensures that the transducer is correctly zeroed when there is no nitrogen flow (if you zero the transducer with the nitrogen supply connected, small nitrogen leaks through the solenoid-valves could affect the calibration).


Use the Setup/Service/Zero Sensors menu to start to zero the transducer, then use the Status menu to display the gas flows; the gas flow displayed will be zero when the transducer has been correctly zeroed. Note that it will take approximately 15 minutes to zero the transducer; if required, you can use the Status/Zero time menu to view the time remaining before the transducer is zeroed.

6.13 Adjust the Pump Display Terminal display viewing angle

If the display (Figure 1-8, item 2) is difficult to see, use the following procedure to adjust the display viewing angle.

1. Refer to Figure 3-8. Remove the Pump Display Terminal (8) from the recess (5) in the dashboard.
2. Place or hold the Pump Display Terminal in its normal operating orientation.
3. Turn the display adjuster (9) clockwise or anticlockwise until the display is easy to read.
4. Refit the Pump Display Terminal (8) in the recess (5) in the dashboard.
5. If necessary, repeat Steps 1 to 4 until the display is easy to see.

6.14 Replace a fuse

	<p style="text-align: center;">WARNING</p> <p>Ensure that you replace a fuse with a new fuse of the correct rating. If you do not, the iK500 system will not be adequately protected and you can damage the iK500 system or cause injury to people. Do not remove the cover from the Electrics Box. High voltages exist in the Electrics Box when it is connected to the electrical supply, and there are no spare parts which you can service in the Module.</p>
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Note: You can only change the fuses in fuse holders F7, F8 and F9. A BOC Edwards service engineer must change fuses F1 to F6 in the Electrics Box (see Figure 1-5).

You can only change the low voltage fuses F7 to F9 for the d.c. electrical supply, the iK500 Interface Module and the emergency stop circuit. If any of the internal fuses F1 to F6 have failed, you must contact your supplier or BOC Edwards for advice. Only change a fuse if you have identified and rectified the cause of the failure.

To change a fuse, refer to Figure 1-5 and use the following procedure. If the fuse immediately fails when you replace it, there may be an electrical fault: contact your supplier or BOC Edwards for advice.


1. Use a flat-bladed screwdriver to undo the fuse holder (13, 14 or 15) by a 1/4 of a turn, then remove the fuse holder from the Electrics Box.
2. Remove the failed fuse from the fuse holder.
3. Fit a new fuse of the correct rating in the fuse holder. Refer to Section 2 for the fuse ratings.
4. Refit the fuse holder in the Electrics Box, then use a flat-bladed screwdriver to turn the fuse holder clockwise by a 1/4 of a turn to secure it in place.


6.15 Replace the Pump Display Terminal

Use the following procedure to replace the Pump Display Terminal. Note that you do not need to switch off the iK500 system to replace the Pump Display Terminal.

1. Refer to Figure 3-7. Remove the Pump Display Terminal (8) from the recess (5) in the dashboard.
2. Remove the connector (4) on the cable (7) from the terminal connector (6) in the recess of the dashboard.
3. Fit the new Pump Display Terminal as described in Section 3.8.1.

6.16 Relocate the iK500 system for maintenance

	<p style="text-align: center;">WARNING</p> <p style="text-align: center;">Use suitable lifting equipment to move the iK500 system.</p>
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	<p style="text-align: center;">WARNING</p> <p style="text-align: center;">System process gases and residue can be highly toxic. Take all necessary precautions when handling components that have, or could have, come into contact with them, including 'O' rings, lubricants, and all exhaust accessories.</p>
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If you want to remove the iK500 system from its operating location and move it to another location where you will do maintenance, use the following procedure.

1. Purge the iK500 system and shut down the iK500 system as described in Section 5.10 and allow the iK500 system to cool down.
2. Refer to Figure 3-12. Disconnect the mating-half from the electrical supply connector (9) on the Electrics Box.
3. Refer to Figure 1-5. Switch off your nitrogen and cooling-water supplies, then disconnect the nitrogen supply pipeline from the nitrogen inlet (4) and disconnect the cooling-water supply and return pipelines from the cooling-water inlet and outlet (3, 2).
4. Refer to Figure 1-1. Disconnect the inlet (1) from your vacuum system and disconnect the outlet (13) from your exhaust-extraction system. Fit blanking caps to your vacuum and exhaust-extraction pipelines and to the iK500 inlet and outlet (1, 13).
5. If necessary, disconnect the iK500 air-extraction port (see Figure 2-1) from your factory extraction system.
6. Refer to Figure 1-1. Adjust the levelling feet (5) so that the iK500 system rests on the castors (6).

7. Refer to Figure 3-6. If necessary (that is, if you will use lifting equipment to move the iH system), refit the four transit brackets to the vibration isolators: refit each transit bracket (2) to the vibration isolator (3), then refit the nuts and washers (4) to secure the transit brackets in place.
8. Move the iK500 system to the location where you will do maintenance.
9. If necessary (depending on the maintenance you will do), disconnect any accessories from the iK500 system.

After maintenance is complete, re-install the iK500 system as described in Section 3.

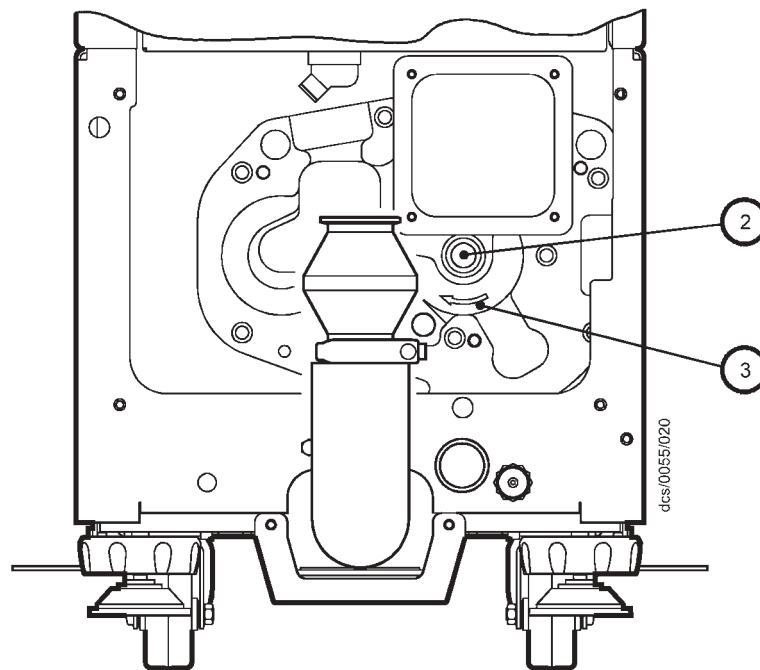
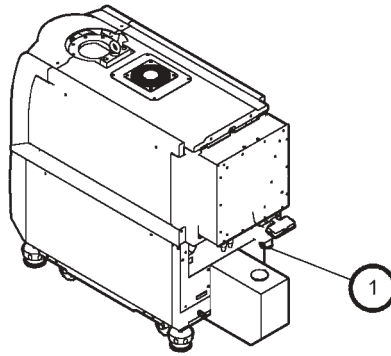
6.17 Check for free rotation of the HCPD pump

	<p>WARNING</p> <p>Hazardous chemicals are located within the pumps and piping. Use of suitable protective gloves and clothing along with respirator is recommended if contact with substances is anticipated.</p>
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If the iK500 has automatically shut down because of excessive HCPD pump-motor power (that is, alarms 412 or 512 are displayed), use the following procedure to check that the pump is free to rotate before you restart the iK500 system:

1. Refer to Figure 3-13. Disconnect the mating-half from the electrical supply connector (9) on the Electrics Box.
2. Refer to Figure 1-5. Undo and remove the four screws which secure the rear cover (1), then remove the cover.
3. Refer to Figure 6-7. Use a 100 mm A/F hexagonal key to remove the $\frac{3}{8}$ BSP plug and 'O' ring (2) from the motor shaft.
4. Fit the hexagonal key to the end of the motor shaft and try to turn the shaft clockwise (in the direction shown by the arrow, 3):
 - If the shaft is free to turn, remove the hexagonal key and continue at Step 5.
 - If the shaft is not free to turn, contact your supplier or BOC Edwards: do not try to restart the iK500 system.
5. Refit the plug and 'O' ring (2) to the motor shaft.
6. Refer to Figure 1-5. Refit the rear cover (1) and secure with the four screws.
7. Refer to Figure 3-13. Refit the mating-half to the electrical supply connector (9) on the Electrics Box.


You can now restart the iK500 system: refer to Section 5.14.



1. Rear cover
2. Plug and 'O' ring: $\frac{3}{8}$ BSP
3. Correct direction of rotation arrow

Figure 6-7 - Try to turn the HCDP pump

6.18 Fault finding

	<p style="text-align: center;">WARNING</p> <p>Only personnel specially trained to perform electrical maintenance should attempt troubleshooting inside electrical enclosures. These enclosures contain hazardous voltages and are not operator areas.</p>
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Before performing maintenance or troubleshooting it is recommended that follow the lockout/tagout procedures according to the Control of Hazardous Energy (Lockout/Tagout) in Volume 29 of the Code of Federal Regulation (29CFR) Section 1910.147 for the customer supply. (See Section 6.19 if the disconnect box is installed).

6.18.1 Warning and alarm message fault finding

When a warning or alarm message is generated, you can display the message and (for some of the messages) two lines of text (the advisory message) which identify possible checks you can make to identify the cause of the fault and to rectify the fault.

The first line of a message specifies the fault condition (warning or alarm) and shows the error number. Error numbers are of the form PFF, PPF or PPPFF, where:

- P, PP, or PPP specifies the fault parameter associated with the alarm or warning: refer to Table 6-5. Note that Table 6-5 defines all of the possible sources; some of these may not be fitted to your iK500 system.
- FF specifies the fault type: refer to Table 6-6.

Table 6-2 shows all of the warning messages, the corresponding lines of advisory text (if any) and the meaning of the error/recommended actions. The warning messages are given in error number order in this table.


Table 6-3 shows all of the alarm messages, the corresponding lines of advisory text (if any) and the meaning of the error/recommended actions. The alarm messages are given in error number order in this table.

Note that Tables 6-2 and 6-3 show all of the possible warning and alarm messages, however some of these messages may not be displayed: this depends on how you have adjusted the setpoints.

6.18.2 Other fault finding

Fault messages will be shown on the Pump Display Terminal to identify that the action you have selected cannot be carried out. The messages which can be displayed and their meanings are shown in Table 6-4.

6.19 Disconnect box and Photohelic Switch/Guage (accessories)

	<p>WARNING</p> <p>Only personnel specially trained to perform electrical maintenance should attempt troubleshooting inside electrical enclosures. These enclosures contain hazardous voltages and are not operator areas.</p>
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Before performing maintenance or troubleshooting it is recommended that follow the lockout/tagout procedures according to the Control of Hazardous Energy (Lockout/Tagout) in Volume 29 of the Code of Federal Regulation (29CFR) Section 1910.147 for the customer supply. Lockout/tagout for the disconnect box are shown in Figure 6-8.

6.19.1 Introduction

Perform the following checks when you maintain your pumping system:

- Check that the disconnect box is securely fitted on the wall.
- Check that all electrical connections are secure and that electrical cables are not damaged.

The disconnect box and photohelic switch/gauge contains no serviceable parts. Repair of faults by the user is limited to replacement of fuses, and resetting of the circuit breakers.

If any other repairs are required, contact your supplier or your nearest BOC Edwards Service Centre for advice.'

6.19.2 Fault Finding

If you suspect that a fault exists in the disconnect box, check the possible causes and carry out the remedial actions described in the following table before returning the disconnect box to a Service Centre.

Symptom	Probable Cause	Recommendations
The disconnect box will not power up	A fuse has blown	Check fuses F1 through F6 and replace if required
	Incoming electrical supply has failed	Check the electrical supply
	Photohelic gauge in warning state.	Recify situation and reset CB1
	Brownout condition over 3 seconds	Recify situation and restart system
Photohelic gauge will not operate	Circuit breaker CB1 tripped	Recify situation and reset CB1

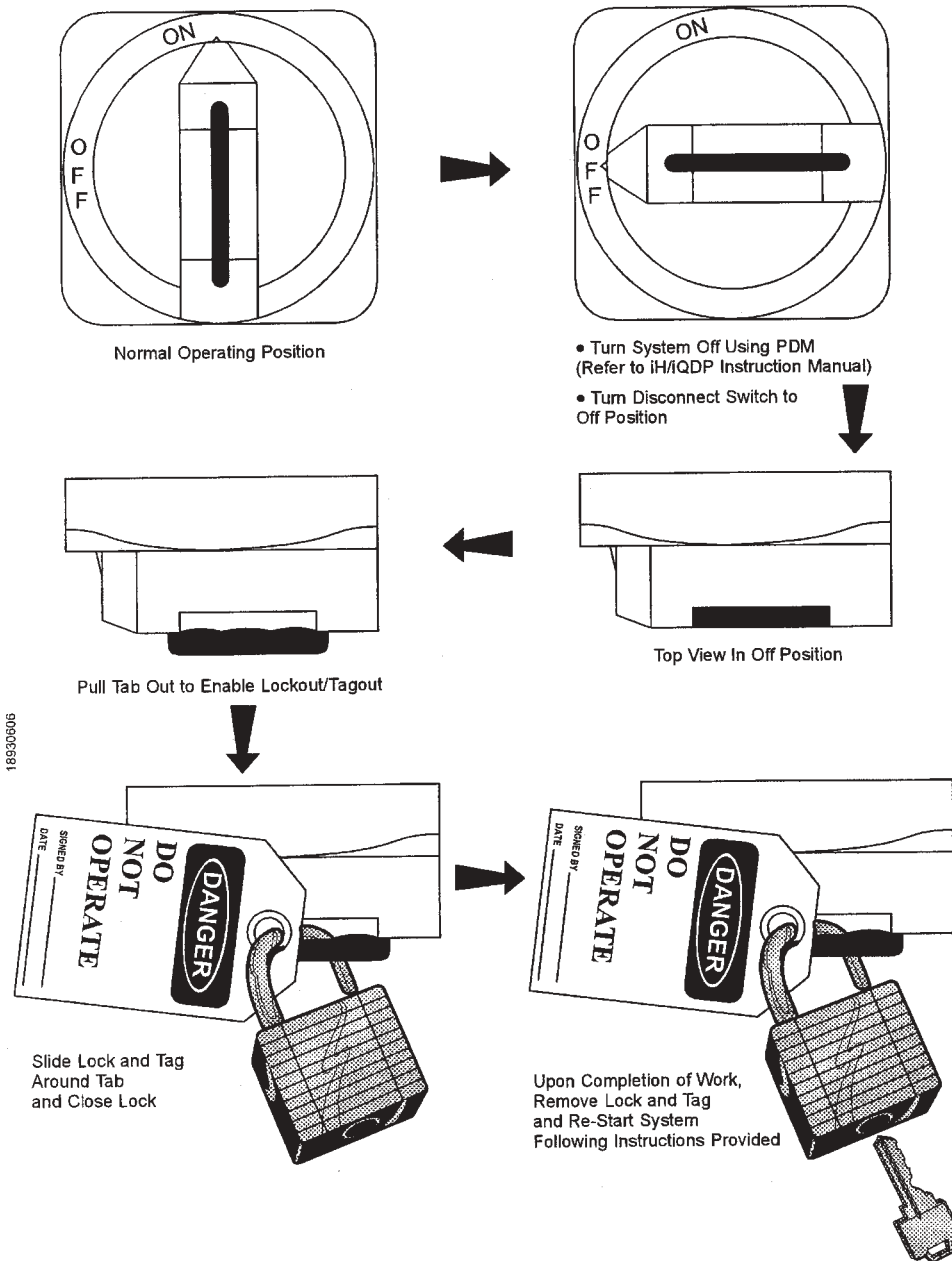


Figure 6-8 - System lockout/tagout procedures

6.19.3 Fuse Replacement

The fuses are mounted in standard fuse holders. The use of a fuse puller is recommended when checking or replacing blown fuses.

If fuse blows regularly, this indicates a probable fault in the disconnect box or electrical connections. Isolate and rectify the fault before reusing the disconnect box.

Warning message	Advisory message	Meaning/recommended action
WARNING 101		(a) there is a fault in the Control SMA, or (b) the emergency stop button has been pressed to shut down the iK500 system, or (c) there has been a transient power supply failure (longer than the hold-up time of the iK500 power supply)
WARNING 113		There is a fault in the ADC (Analogue-to-digital convertor) in the Control SMA; the Control SMA must be replaced.
WARNING 209	SEE MANUAL	The electrical supply voltage is too low. Check the electrical supply and the connections to the iK500 system and rectify as necessary.
WARNING 211	SEE MANUAL	The electrical supply voltage is too high. Check the electrical supply and the connections to the iK500 system and rectify as necessary.
WARNING 309 DP CURRENT LOW	OPEN CIRCUIT CHECK CONNECTION	The electrical current drawn by the HCDP pump is less than normal. Check that the electrical connections are correct and rectify as necessary. If the electrical connections are correct, a fuse in the Electrics Box may have failed.
WARNING 311 DP CURRENT HIGH	LEAK/DEBRIS SERVICE PUMP	The electrical current drawn by the HCDP pump is higher than normal. There may be a leak in the system or process debris in the pump, or the pump motor may have failed. Inspect the pipelines and service the pump.
WARNING 409 DP POWER LOW	OPEN CIRCUIT CHECK CONNECTION	The electrical power consumption of the HCDP pump is less than normal. Check that the electrical connections are correct and rectify as necessary. If the electrical connections are correct, a fuse in the Electrics Box may have failed.

Table 6-2 - Warning messages

Warning message	Advisory message	Meaning/recommended action
WARNING 411 DP POWER HIGH	LEAK/DEBRIS SERVICE PUMP	The electrical power consumption of the HCDP pump is higher than normal. There may be a leak in the system or process debris in the pump, or the pump motor may have failed. Inspect the pipelines and service the pump.
WARNING 412 DP POWER HIGH	LEAK/DEBRIS SERVICE PUMP	Refer to the recommended actions for error number 411 in this table.
WARNING 509	SEE MANUAL	The HCDP motor thermistor is short circuited. Check the thermistor connections inside the HCDP pump motor terminal-box and check the connections between the HCDP pump and the Electrics Box.
WARNING 611	SEE MANUAL	There is a phase imbalance in the electrical supply to the HCDP pump. Check the electrical supply and the connections to the iK500 system. If the electrical supply and connections are correct, the pump motor may be faulty.
WARNING 709 MB CURRENT LOW	OPEN CIRCUIT CHECK CONNECTION	The electrical current drawn by the QMB pump is lower than normal. Check that the electrical connections are correct and rectify as necessary. If the electrical connections are correct, a fuse in the Electrics Box may have failed or the gearbox coupling may have failed or the coupling-cover oil-level may be too low.
WARNING 711 MB CURRENT HIGH	LEAK/DEBRIS SERVICE PUMP	The electrical current consumption of the QMB pump is higher than normal. There may be a leak in the system or process debris in the pump, or the pump motor may have failed or the coupling-cover oil-level may be too low. Inspect the pipelines and service the pump.
WARNING 809 MB POWER LOW	OPEN CIRCUIT CHECK CONNECTION	The electrical power consumption of the QMB pump is lower than normal. Check that the electrical connections are correct and rectify as necessary. If the electrical connections are correct, a fuse in the Electrics Box may have failed.
WARNING 811 MB POWER HIGH	LEAK/DEBRIS SERVICE PUMP	The electrical power consumption of the QMB pump is higher than normal. There may be a leak in the system or process debris in the pump or the pump motor may have failed. Inspect the pipelines and service the pump.
WARNING 812 MB POWER HIGH	LEAK/DEBRIS SERVICE PUMP	Refer to the recommended actions for error number 811 in this table.

Table 6-2 - Warning messages (continued)

Warning message		Advisory message	Meaning/recommended action
WARNING	909	SEE MANUAL	The QMB motor thermistor is short circuited. Check the thermistor connections inside the QMB pump motor terminal-box and check the connections between the QMB pump and the Electrics Box.
WARNING	1011	SEE MANUAL	There is a phase imbalance in the electrical supply to the QMB pump. Check the electrical supply and the connections to the iK500 system. If the electrical supply and connections are correct, the pump motor may be faulty.
WARNING	1201		When started, no electrical current was drawn by the HCDP pump. Check whether the pump motor is open circuit. If not, the current sensor may have failed.
WARNING	1401 SERVICE DUE (R)	xxxxx HRS RUN SINCE SERVICE	The iK500 system has operated for xxxxx hours since it was last serviced. Service the iK500 system.
WARNING	1601 SERVICE DUE (P)	xxxxx HRS RUN SINCE SERVICE	The iK500 system has operated for xxxxx hours since it was last serviced. Service the iK500 system.
WARNING	1801 SERVICE DUE (P)	xxxxx CYCLES SINCE SERVICE	The iK500 system has been operated for xxxxx process cycles since it was last serviced. Service the iK500 system.
WARNING	2001 SERVICE DUE (C)	xxxxx CYCLES SINCE SERVICE	The iK500 system has been operated for xxxxx switch-on/off cycles since it was last serviced. Service the system.
WARNING	3113		There is a fault in the ADC (Analogue-to-digital convertor) in the Control SMA; the Control SMA must be replaced.
WARNING	3501		(a) the gas module mass flow transducer has drifted outside the valid range allowed for zeroing, or (b) you cannot zero the transducer because the nitrogen purge is switched on or the HCDP pump is on.
WARNING	3509 TOTAL N2 FLOW LO	FLOW LOW CHECK GAS MODULE	The total nitrogen flow is too low. There may be a fault in the Gas Module.
WARNING	3511 TOTAL N2 FLOW HI	FLOW HIGH CHECK GAS MODULE	The total nitrogen flow is too high. There may be a fault in the Gas Module.

Table 6-2 - Warning messages (continued)

Warning message	Advisory message	Meaning/recommended action
WARNING 3911 EXHAUST PRESSURE	EXHAUST BLOCKED SERVICE PUMP	The pressure in the exhaust pipeline is too high. There may be process debris or condensation in the exhaust pipeline, or a valve in the pipeline may be shut. You may have too many pumping systems connected to the exhaust pipeline.
WARNING 3913		The exhaust pressure transducer is not fitted, or is disconnected or has failed. Check and rectify as necessary.
WARNING 4009 SS PURGE LOW	ADJUST REGULATOR INCREASE PRESS.	The shaft-seals purge pressure is too low. Check that the nitrogen supply is as specified in Section 2 and that you have correctly adjusted the pressure: refer to Section 5.7.
WARNING 4010 SS PURGE LOW	PRESSURE LOW ADJUST REGULATOR	Refer to the recommended actions for error number 4009 in this table.
WARNING 4011 SS PURGE HIGH	PRESSURE HIGH CHECK GAS MODULE	The shaft-seals purge pressure is too high. Check that you have correctly adjusted the pressure: refer to Section 5.7. If you cannot correctly adjust the pressure, the regulator may be faulty.
WARNING 4012 SS PURGE HIGH	PRESSURE HIGH CHECK GAS MODULE	Refer to the recommended actions for error number 4011 in this table.
WARNING 4013		The shaft-seals pressure transducer is not fitted, or is disconnected or has failed. Check and rectify as necessary.
WARNING 5113		There is a fault in the ADC (Analogue-to-digital convertor) in the Control SMA; the Control SMA must be replaced.
WARNING 5411 MB TEMP		The temperature of this QMB pump is too high. Check the pumping system inlet pressure; has the pumping system been operating with inlet pressure $>5 \text{ mbar}$ ($5 \times 10^2 \text{ Pa}$) for 1 hour or more. If the maximum inlet pressure has not been exceeded, the cooling circuit of the pump may be blocked.
WARNING 5413		Check that the QMB pump temperature sensor is fitted and is correctly connected. If the sensor is correctly fitted and connected, it may have failed. Check the operation of the sensor and replace it if it has failed.

Table 6-2 - Warning messages (continued)

Warning message	Advisory message	Meaning/recommended action
WARNING 5511 DP MOTOR TEMP	MOTOR WATER LOW CHECK WATER	The temperature of the HCDP pump- motor is too high. Check the cooling-water connections in the iK500 system and check that the cooling-water supply is on and is as specified in Section 2. If the connections and supply are correct, the cooling-circuit of the pump maybe blocked.
WARNING 5513		The QMB pump temperature sensor is not fitted, or is disconnected or has failed.
WARNING 5609 EXHAUST TEMP LOW	EXHAUST TEMP LOW CHECK EXHAUST	The temperature of the exhaust is too low for the process.
WARNING 5613		You have configured the iK500 to have an exhaust temperature sensor fitted, but the sensor is not fitted, or is disconnected or has failed. Check and rectify as necessary.
WARNING 5709 DP TEMP LOW	DP TEMP LOW SEE MANUAL	The operating temperature of the HCDP pump is too low:.
WARNING 5711 DP TEMP HIGH	DP TEMP HIGH SEE MANUAL	The operating temperature of the HCDP pump is too high: there may be process debris in the pump or the pump may be damaged.
WARNING 5713		The HCDP pump-body temperature sensor is not fitted, or is disconnected or has failed. Check and rectify as necessary.
WARNING 6001 WATER FLOW LOW	CHECK COOLING WATER SUPPLY	The flow of cooling-water through the iK500 system is too low. Refer to the recommended actions for error number 5411.
WARNING 11101		There is a fault in the NIM (Network Interface Module): refer to the instruction manual supplied with the NIM.
WARNING 12101		There is a fault in the Tool Interface Card in the iK500 Interface Module. Refer to the instruction manual supplied with the iK500 Interface Module.
WARNING 15101		There is a fault in the Auxiliary Interface Card in the iK500 Interface Module. Refer to the instruction manual supplied with the iK500 Interface Module.
WARNING 15201		The gate valve connected to the iK500 Interface Module has failed to close.
WARNING 15301		The gate valve connected to the iK500 Interface Module has failed to open.

Table 6-2 - Warning messages (continued)

Alarm message	Advisory message	Meaning/recommended action
ALARM 101 STOP ACTIVATED		The emergency stop switch has been pressed or a safety sensor connected to the emergency stop circuit has operated (or your remote emergency off circuit has operated) to shut down the iK500 system. Note that the message will remain on the display until you restart the pumping system.
ALARM 101		Refer to the recommended actions for error number 101: see Table 6-2.
ALARM 210		Refer to the recommended actions for error number 209: see Table 6-2.
ALARM 212		Refer to the recommended actions for error number 211: see Table 6-2.
ALARM 310 DP CURRENT LOW	OPEN CIRCUIT CHECK CONNECTION	Refer to the recommended actions for error number 309: see Table 6-2.
ALARM 312 DP CURRENT HIGH	LEAK/DEBRIS SERVICE PUMP	Refer to the recommended actions for error number 311: see Table 6-2.
ALARM 410 DP POWER LOW	OPEN CIRCUIT CHECK CONNECTION	Refer to the recommended actions for error number 409: see Table 6-2.
ALARM 412 DP POWER HIGH	LEAK/DEBRIS SERVICE PUMP	Refer to the recommended actions for error number 411: see Table 6-2.
ALARM 512		The pump-motor has tripped out because the motor windings are too hot: either the cooling-system has failed or the motor overloaded. Either of these faults should have been identified before shut-down, so either there are two separate faults (for example, cooling-water supply failure and thermocouple circuit failure) or the thermistor circuit has failed: contact your supplier or BOC Edwards.
ALARM 612		Refer to the recommended actions for error number 611: see Table 6-2.
ALARM 710 MB CURRENT LOW	OPEN CIRCUIT CHECK CONNECTION	Refer to the recommended actions for error number 709: see Table 6-2.
ALARM 712 MB CURRENT HIGH	LEAK/DEBRIS SERVICE PUMP	Refer to the recommended actions for error number 711: see Table 6-2.
ALARM 810 MB POWER LOW	OPEN CIRCUIT CHECK CONNECTION	Refer to the recommended actions for error number 809: see Table 6-2.
ALARM 812 MB POWER HIGH	LEAK/DEBRIS SERVICE PUMP	Refer to the recommended actions for error number 811: see Table 6-2.

Table 6-3 - Alarm messages

Alarm message	Advisory message	Meaning/recommended action
ALARM 912		Refer to the recommended actions for error number 512 in this table.
ALARM 1012		Refer to the recommended actions for error number 1011: see Table 6-2.
ALARM 1101		(a) the electrical supply is not connected to the HC DP pump motor, or (b) the phase sequence of the electrical supply to the pump is incorrect: reverse two of the phases in the electrical supply connector: refer to Section 3.16.3.
ALARM 3912 EXHAUST PRESSURE	EXHAUST BLOCKED SERVICE PUMP	Refer to the recommended actions for error number 3911: see Table 6-2.
ALARM 5412 MB TEMP	MB TEMP HIGH SEE MANUAL	Refer to the recommended actions for error number 5411: see Table 6-2.
ALARM 5512 DP MOTOR TEMP	MOTOR WATER LOW CHECK WATER	Refer to the recommended actions for error number 5511: see Table 6-2.
ALARM 5610 EXHAUST TEMP LOW	EXHAUST TEMP LOW CHECK EXHAUST	Refer to the recommended actions for error number 5609: see Table 6-2.
ALARM 5710 DP TEMP LOW	DP TEMP LOW SEE MANUAL	Refer to the recommended actions for error number 5709: see Table 6-2.
ALARM 5712 DP TEMP HIGH	DP TEMP HIGH SEE MANUAL	Refer to the recommended actions for error number 5711: see Table 6-2.

Table 6-3 - Alarm messages (continued)

Message	Meaning
CONTROL failed Press CANCEL	You have requested that the Pump Display Terminal takes control of the iK500 system, but the attempt to take control has failed. Press the CANCEL button to return to normal display.
CONTROL REMOTE Press CANCEL	(a) You have requested that the Pump Display Terminal takes control of the iK500 system, but another module still has control. Press the CANCEL button to return to normal display, release control from the module which currently has control and then try again. (b) You have requested some action, but the Pump Display Terminal does not have control of the iK500 system. Press the CANCEL button, take control and then try again.
PUMP failed to respond (CANCEL)	(a) You have requested that the iK500 system is switched on or off, but the pump(s) has failed to start or stop: press the CANCEL button to cancel the request, identify and rectify the cause for the failure of the pump(s) to start or stop, then try again. (b) You have tried to open or close one of the gate valves (if fitted), but the valve has failed to respond. Identify and rectify the cause for the failure of the valve to open or close, then try again. (c) A value (for example, a setpoint) has been requested from the iK500 system, but the iK500 system has not responded. (d) The emergency stop switch has been pressed and released: restart the pumping system.
PUMP RUNNING Press CANCEL	You have requested that the iK500 system is switched on, but it is already on. Press the CANCEL button to return to normal display.
PUMP STOPPED Press CANCEL	You have requested that the iK500 system is switched off, but it is already off. Press the CANCEL button to return to normal display.
EDWARDS DISPLAY MODULE	If this message is displayed when the iK500 system is switched on and the display does not change to normal display, this means that the Pump Display Terminal cannot correctly communicate with the iK500 system.
None (the display is blank)	One or both of fuses FS6 and FS8 may have tripped. Switch off the electrical supply to the iK500 system, then switch it on again to reset the fuse(s).

Table 6-4 - Fault messages

Parameter [†]	Source/cause of error
1	iK500 system status
2	Electrical supply voltage
3	HCDP pump current consumption
4	HCDP pump power consumption
5	HCDP pump-motor thermistor
6	Phase imbalance in HCDP pump current consumption
7	QMB pump current consumption
8	QMB pump power consumption
9	QMB pump-motor thermistor
10	Phase imbalance in QMB pump current consumption
11	HCDP pump status
12	QMB pump status
14	Total run hours (since last service)
16	Total run hours (on process, since last service)
18	Process cycles (since last service)
20	Switch-on/off cycles (since last service)
31	Gas Module status
35	Gas Module flow transducer: total nitrogen purge flow
39	Exhaust pressure sensor
40	Shaft-seals purge pressure transducer
51	Electronics Module status
53	Active Gauge (optional accessory)
54	QMB pump temperature sensor
55	HCDP pump-motor water manifold surface temperature sensor
56	iK500 exhaust temperature sensor (optional accessory)
57	HCDP pump-body thermocouple
111	Network Interface Module status (optional accessory)
121	Tool Interface Card status (optional accessory)
151	Auxiliary Interface Card status (optional accessory)
152	Gate Valve Closed status
153	Gate Valve Open status

[†] First digit of a three-digit error number, first two digits of a four-digit error number, or first three digits of a five-digit error number.

Table 6-5 - Fault parameters

Fault type ▲	Meaning
01	Digital alarm condition *
09	Low warning condition
10	Low alarm condition
11	High warning condition
12	High alarm condition
13	Device error †

▲ Last two digits of the error number.

* For example, the gas module flow transducer has drifted outside the valid range allowed for zeroing.

† For example, sensor is not fitted, or is disconnected.

Table 6-6 - Fault types

7 STORAGE AND DISPOSAL

7.1 Storage

CAUTION

Drain the cooling-water from the iK500 system, if you will transport or store it in conditions where the cooling-water could freeze. If you do not, cooling-water may freeze in the iK500 system and damage the pump(s) and/or the cooling-water pipelines.

Store the iK500 system as follows :

1. If applicable, ensure that the pumps have been shut down as described in Section 5.10 and disconnect all services, process and exhaust connections.
2. Fit blanking-plates to all vacuum inlets and exhaust outlets. Place protective covers over the iK500 services connection points.
3. Store the iK500 system in clean dry conditions until required.
4. When required for use, prepare and install the iK500 system as described in Section 3 of this manual.

7.2 Disposal

Dispose of the iK500 system and any components safely in accordance with all local and national safety and environmental requirements.

Take particular care with the following:

- Fluoroelastomers which may have decomposed as the result of being subjected to high temperatures
- Components which have been contaminated with dangerous process substances.

8 SERVICE, SPARES AND ACCESSORIES

8.1 Introduction

BOC Edwards products, spares and accessories are available from BOC Edwards companies in Belgium, Brazil, Canada, China, France, Germany, Israel, Italy, Japan, Korea, Singapore, Switzerland, United Kingdom, U.S.A and a world-wide network of distributors. The majority of these centres employ Service Engineers who have undergone comprehensive BOC Edwards training courses.

Order spare parts and accessories from your nearest BOC Edwards company or distributor. When you order, please state for each part required:

- Model and Item Number of your equipment
- Serial number (if any)
- Item Number and description of the part.

8.2 Service

BOC Edwards products are supported by a world-wide network of BOC Edwards Service Centres. Each Service Centre offers a wide range of options including: equipment decontamination; service exchange; repair; rebuild and testing to factory specifications. Equipment which has been serviced, repaired or rebuilt is returned with a full warranty.

Your local Service Centre can also provide BOC Edwards engineers to support on-site maintenance, service or repair of your equipment.

For more information about service options, contact your nearest Service Centre or other BOC Edwards company.

8.3 Spares

Pump - Spares	Item Number
iH Pump Display Terminal	D372-72-800
Krytox 1525 oil (1 kg)	H113-09-018
Fomblin 25/6 oil (1 kg)	H113-12-019
Drynert 25/6 oil (1 kg)	H113-12-021
Exhaust check-valve servicing kit	A440-03-820
iK500 Exhaust Service Kit	A505-92-000
Terminator plug (4 way)	A532-20-050
Exhaust-pipe (with metal 'O' ring)	A505-52-000
Metal 'O' ring (for HCDP outlet to exhaust-pipe connection): pack of 10	H021-15-001
Oil filler-plug 'O' ring: pack of 10	H021-06-110
iK500 Exhaust Pipe Kit (complete 2-part system)	A505-52-000

Booster - Spares	Item Number
RT15 Fomblin grease (100gm)	H113-50-003
End-cover 'O' ring (QMB250F and QMB500F)	H021-22-091
Gear-cover 'O' ring (QMB1200F)	H021-22-159
Fomblin YVAC 16/6 fluid (1kg)	H113-06-019
Fomblin YVAC 16/6 fluid (5kg)	H113-06-020
Krytox 1514 fluid (1kg)	H113-08-018
Krytox 1514 fluid (5kg)	H113-08-020

8.4 Ordering accessories

Note: All of the accessories in Section 8.4.1 to 8.4.4 must be ordered when you order your iK500 system. The accessories you have ordered will be supplied fitted to your iK500 system.

8.4.1 Exhaust Temperature Sensor

The Exhaust Temperature Sensor monitors the temperature in the iK500 exhaust outlet. When fitted, the outputs of the Sensor are monitored by the iK500 system. If required, you can configure the iK500 system to generate a warning if the exhaust temperature is too low or too high.

Accessory	Item Number
Exhaust Temperature Sensor	A532-07-000

8.4.2 Active Gauge Connection Kit

The Active Gauge Connection Kit allows the iK500 system to monitor the pressure measured by an Active Gauge fitted in the inlet pipeline to the iK500 system.

The Connection Kit is suitable for use with any of the following BOC Edwards Active Gauges:

- ATC-M Active Thermocouple Gauge
- ASG (1000 mbar) Active Strain Gauge
- APG-MP Active Pirani Gauge
- APG-L Active Pirani Gauge (Heated)
- Barocel Capacitance Manometers (10 to 1000 mbar or torr).

When supplied, the Active Gauge Connection Kit is configured for use with an APG-MP Active Pirani Gauge. You will need to fit an iK PC Interface Kit if you want to reconfigure the iK500 system for use with another gauge type (see Section 8.5.5).

Accessory	Item Number
Active Gauge Connection Kit	D372-41-000

8.4.3 Enclosure Extraction Fan Kit

When fitted, an Enclosure Extraction Fan Kit provides air-extraction of the iK500 enclosure at a rate of 2.8 m³min⁻¹ (100 cfm).

Accessory	Item Number
Enclosure Extraction Fan Kit	A505-39-000

8.5 Other accessories

8.5.1 Communications Module

Fit a Communications Module accessory to allow your Process Tool or PC-based software to control and monitor the operation of the iK500 system through a serial port or through a parallel port, with a small number of digital lines:

- Serial port communications use the RS232C communications protocol.
- Parallel port communications implement a sub-set of the iK500 Tool Interface Module communications. A single digital control input is used to turn the pump(s) on and off, and four digital outputs provide pump(s) on, warning and alarm status outputs.

Accessory	Item Number
Serial Communications Module	D372-32-000
Serial and Parallel Communications Module	D372-35-000
Parallel Communications Module	D372-36-000

8.5.2 Interface Modules

The Interface Module allows you to control the operation of the iK500 system through your Process Tool or other control equipment.

The Interface Module can be fitted with one or more Tool Interface Card and/or one or more Auxiliary Interface Card.

The Tool Interface Card allows you to control and monitor the status of the iK500 system through your process tool or other control equipment. The Tool Interface Card has a setpoints store. The setpoints store can be preset to contain sensor setpoints suitable for a particular process or application (that is, the combination of the iK500 system configuration, process chemistry and user's production pattern). If you have a Tool Interface Card fitted, you can use the application recipe at any time (instead of the default setpoints in the iK500 system).

The Auxiliary Interface Card allows you to control the operation of other equipment (such as inlet and outlet isolation-valves) connected to the iK500 system.

Contact your supplier or BOC Edwards if you want to order Interface Modules.

8.5.3 iK500 Single Pumpset Monitor and iK500 Fabworks

The iK500 Single Pumpset Monitor allows you to monitor pump parameters and configure the iK500 system. The iK500 Fabworks allows you to network together all of the iK500 systems in your installation and to use a PC to centrally monitor the iK500 systems. Contact your supplier or BOC Edwards if you want to network your iK500 systems.

8.5.4 PC Interface Kits

The PC Interface Kit allows you to directly connect the iK500 system to a laptop PC or to a desktop PC and to use the PC to switch the iK500 system on and off, and to monitor the status of the iK system. The Kit is supplied with all necessary cables and with the iK500 Single Pumpset Monitor software.

Accessory	Item Number
Desktop PC Interface Kit	D372-18-100
Laptop PC Interface Kit (USA)	D372-18-200
Laptop PC Interface Kit (Europe)	D372-18-300
Laptop PC Interface Kit (UK)	D372-18-400
Laptop PC Interface Kit (Japan)	D372-18-500
PCMCIA Laptop PC Interface Kit	D372-17-000

8.5.5 iK500 Alternative Connections Kits

Use this kit to reconfigure the iK500 system to use the alternative nitrogen inlet and/or cooling-water inlet and outlet connection positions (see Section 3.5).

Accessory	Item Number
Alternative Nitrogen and Cooling-Water Connections Kit	A505-34-000

8.5.6 iH Alternative Exhaust Kit

This kit provides the user with O-rings and insulation jackets to fit to the exhaust pipe in the reversed position.

Accessory	Item Number
iK Alternative Exhaust Kit	A505-33-000

8.5.7 iH Nitrogen Flow Switch

When installed, the Flow Switch enables the iH communications Module to monitor the flow of nitrogen purge gas to the dry pumping system, and shut down the dry pumping system if the flow is too low.

Accessory	Item Number
iH Nitrogen Flow Switch	A532-54-000

8.5.8 iK500 Pump Display Module

When fitted, the iK500 Pump Display Module allows the operator to manually control the pump (as with the Pump Display Terminal), but with the option of communicating over distances in excess of 25m.

Accessory	Item Number
iK500 Pump Display Module	D372-37-000

8.5.9 Pump Display Module extension cables

If required, you can use an extension cable to allow you to use the Pump Display Module further away from the iK500 system.

Accessory	Item Number
Extension cable (display/interface), 3 m	D372-07-591
Extension cable (display/interface), 5 m	D372-07-592
Extension cable (display/interface), 10 m	D372-07-595
Extension cable (display/interface), 15 m	D372-07-596
Extension cable (display/interface), 25 m	D372-07-597

8.5.10 iK500 Pump Display Terminal extension cables

If required, you can use an extension cable to allow you to use the Pump Display Terminal further away from the iK500 system.

Accessory	Item Number
Extension cable (display interface), 3m	D372-72-801
Extension cable (display interface), 5m	D372-72-802
Extension cable (display interface), 10m	D372-72-803
Extension cable (display interface), 15m	D372-72-804
Extension cable (display interface), 25m	D372-72-805

8.5.11 iK500 Disconnect Box

When fitted, the iK500 disconnect box allows the isolation of the electrical supply for an emergency, maintenance or troubleshooting of the system.

Accessory	Item Number
iK500 Disconnect Box	U20000445

8.5.12 iK500 Photohelic Switch/Gauge Kit

When fitted, the iK500 photohelic switch./gauge kit will isolate the electrical supply to the system, via the disconnect box, should the pressure in the enclosure exceed a certain setpoint.

Accessory	Item Number
iK500 Photohelic Switch/Gauge Kit	U30004021

Return of BOC Edwards Equipment - Procedure

INTRODUCTION

Before returning your equipment, you must warn BOC Edwards if substances you used (and produced) in the equipment can be hazardous. This information is fundamental to the safety of our Service Centre employees and will determine the procedures employed to service your equipment.

Complete the Declaration (HS2) and send it to BOC Edwards before you dispatch the equipment. It is important to note that this declaration is for BOC Edwards internal use only, and has no relationship to local, national or international transportation safety or environmental requirements. As the person offering the equipment for shipment, it is your responsibility to ensure compliance with applicable laws.

GUIDELINES

- Equipment is '**uncontaminated**' if it has not been used, or if it has only been used with substances that are not hazardous. Your equipment is '**contaminated**' if it has been used with any substances classified as hazardous under EU Directive 67/548/EEC (as amended) or OSHA Occupational Safety (29 CFR 1910).
- If your equipment has been used with radioactive substances, biological or infectious agents, mercury, polychlorinated biphenyls (PCB's), dioxins or sodium azide, you must decontaminate it before you return it to BOC Edwards. You must send independent proof of decontamination (for example a certificate of analysis) to BOC Edwards with the Declaration (HS2). Phone BOC Edwards for advice.
- If your equipment is contaminated, you must either:
 - Remove all traces of contamination (to the satisfaction of laws governing the transportation of dangerous/hazardous substances).
 - Or, properly classify the hazard, mark, manifest and ship the equipment in accordance with applicable laws governing the shipment of hazardous materials.

Note: Some contaminated equipment may not be suitable for airfreight.

PROCEDURE

1. Contact BOC Edwards and obtain a Return Authorisation Number for your equipment.
2. Complete the Return of BOC Edwards Equipment - Declaration (HS2).
3. If the equipment is contaminated, you must contact your transporter to ensure that you properly classify the hazard, mark, manifest and ship the equipment, in accordance with applicable laws governing the shipment of contaminated/hazardous materials. As the person offering the equipment for shipment, it is your responsibility to ensure compliance with applicable law. **Note: Equipment contaminated with some hazardous materials, such as semiconductor by-products, may not be suitable for airfreight - contact your transporter for advice.**
4. Remove all traces of hazardous gases: pass an inert gas through the equipment and any accessories that will be returned to BOC Edwards. Where possible, drain all fluids and lubricants from the equipment and its accessories.
5. Seal up all of the equipment's inlets and outlets (including those where accessories were attached) with blanking flanges or, for uncontaminated product, with heavy gauge tape.
6. Seal equipment in a thick polythene/polyethylene bag or sheet.
7. If the equipment is large, strap the equipment and its accessories to a wooden pallet. If the equipment is too small to be strapped to a pallet, pack it in a suitable strong box.
8. Fax or post a copy of the Declaration (HS2) to BOC Edwards. The Declaration must arrive before the equipment.
9. Give a copy of the Declaration (HS2) to the transporter. You must tell your transporter if the equipment is contaminated.
10. Seal the original Declaration in a suitable envelope: attach the envelope securely to the outside of the equipment package, in a clear weatherproof bag.

WRITE YOUR RETURN AUTHORISATION NUMBER CLEARLY ON THE OUTSIDE OF THE ENVELOPE OR ON THE OUTSIDE OF THE EQUIPMENT PACKAGE.

Return of BOC Edwards Equipment - Declaration

Return Authorisation Number: _____

You must:

- Know about all of the substances which have been used and produced in the equipment before you complete this Declaration
- Read the Return of BOC Edwards Equipment - Procedure (HS1) before you complete this Declaration
- Contact BOC Edwards to obtain a Return Authorisation Number and to obtain advice if you have any questions
- Send this form to BOC Edwards before you return your equipment

SECTION 1: EQUIPMENT

Equipment/System Name _____

Part Number _____

Serial Number _____

Has the equipment been used, tested or operated ?

YES Go to Section 2 NO Go to Section 4

IF APPLICABLE:

Tool Reference Number _____

Process _____

Failure Date _____

Serial Number of Replacement Equipment _____

SECTION 2: SUBSTANCES IN CONTACT WITH THE EQUIPMENT

Are any substances used or produced in the equipment:

- Radioactive, biological or infectious agents, mercury, poly chlorinated biphenyls (PCBs), dioxins or sodium azide? (if YES, see Note 1) YES NO
- Hazardous to human health and safety? YES NO

Note 1 : BOC Edwards will not accept delivery of any equipment that is contaminated with radioactive substances, biological/infectious agents, mercury, PCB's, dioxins or sodium azide, unless you:

- Decontaminate the equipment
- Provide proof of decontamination

YOU MUST CONTACT BOC EDWARDS FOR ADVICE BEFORE YOU RETURN SUCH EQUIPMENT

SECTION 3: LIST OF SUBSTANCES IN CONTACT WITH THE EQUIPMENT

Substance name	Chemical Symbol	Precautions required (for example, use protective gloves, etc.)	Action required after a spill, leak or exposure

SECTION 4: RETURN INFORMATION

Reason for return and symptoms of malfunction _____

- If you have a warranty claim:
- who did you buy the equipment from ? _____
 - give the supplier's invoice number _____

SECTION 5: DECLARATION

Print your name: _____ Print your job title: _____

Print your organisation: _____

Print your address: _____

Telephone number: _____ Date of equipment delivery: _____

I have made reasonable enquiry and I have supplied accurate information in this Declaration. I have not withheld any information, and I have followed the Return of BOC Edwards Equipment - Procedure (HS1).

Note: Please print out this form, sign it and return the signed form as hard copy.

Signed: _____ Date _____

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